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Environmental analysis of winter game range in Western Montana

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AN ENVIRONMENTAL ANALYSIS

of

WINTER GAME RANGE

in

WESTERN MONTANA

by

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INTRODUCTION

The forests and prairies of Montana formerly provided food and cover for vast herds of deer and elk. Before the inroads of agriculture, deer and elk were encountered mainly on the prairies and in the mountain valleys (Rush 1932, West 1941). After 1875 the deer and elk began their movement into the forests and mountains. Between 1805, when the Lewis and Clark expedition visited western Montana, and 1875 there were periods of plenty and scarcity of game (Rush 1932, West 1941).

The shifting of deer and elk to a more or less forest habitat was influenced by the heavy hunting pressure and agricultural extension that held the animal population in check, and the heavy logging and fires that provided better range in the forested country.

As communities became stabilized and the state was admitted to the Union, the enactment of conservation laws and provisions for enforcement became a reality. Regulated kills allowed the animals to thrive and increase. No conflicts were evident for many years but gradually heavier winter kills were noted, forage took on a hedged appearance and in some areas elk were reported to be replacing deer.

Ever increasing reports of competition between deer and elk have been made by sportsman and technicians. These

reports at best are made on the basis of limited observations and conjecture. Accumulating bag records and more intensive observations will show these trends. But are these trends due to some environmental change or to a direct inter-specific change? This change indicates a need for a study of the environmental and inter-specific relationships of deer and elk.

The restoration program of the Montana Fish and Game Department and the recent pressure of certain sportsman groups, in Montana, for use of excess Yellowstone Park elk as restocking material, requires careful consideration of the environmental needs of the game animals. The hunter demands need to be related to the character of various ranges, their ability to supply the right kind and quality of game, and the kind and amount of hunting pressure exhibited by sportsmen.

STATEMENT OF PROBLEM

In order to provide criteria for an evaluation of game range, this thesis reports on a study of environmental factors associated with observed distribution of white-tailed deer (Odocoileus virginianus ochrourus), Rocky Mountain mule deer (Odocoileus hemionus hemionus), and the Rocky Mountain wapiti or elk (Cervus canadensis nelsoni) on winter game range, in Western Montana. The winter range is limited and it is here that conflict between animals may occur. In addition to the investigation of environmental characteristics, a technique for classifying factors of environment is presented.

This thesis is limited in that the results are based on one years observations in twenty-two areas. The sampling and data may be considered somewhat limited in that only relationships rather than absolute values of game requirements can be established from the data. Climatic variations from year to year would influence the pattern, making it necessary to continue this project for five or ten years to fully investigate the influence of the climatic fluctuations and include other areas. However, the results of this investigation do present a definite procedure as well as provide a means of appraising methodology for future work.

LITERATURE REVIEW

The majority of the research work on competition involving big game has been concerned with game range requirements and the relations between livestock and big game. This is due no doubt to the economic considerations involved. Essentially, this competition involved the conflict for food. Roberts (1930), Pickford & Reid (1943), Stoddart & Rasmussen (1945), Schwan (1945), and others have clearly demonstrated that conflict between livestock and game exists to a greater or lesser extent depending on species of plants or animals concerned.

There is no doubt that workers are concerned with the problem of competition because of the general comments in the references to it. The comments on the subject have been many and varied; for example, Rush (1932) quoting from reports of the Superintendent of Yellowstone Park said that elk and deer were compatabile because they were feeding close together. This immediately implies no conflict, yet there is a definite increase of elk in the Park and a loss of the deer.

Roberts (1930) reported the replacement of mule deer by elk on the Sitgraves National Forest in Arizona as an outgrowth of a release, made earlier in the century, of elk

from Yellowstone Park. In the Selway and Lochsa areas of Idaho, deer were very abundant around 1910. After the "big fire" and logging operations, a vast area of excellent range allowed the elk to increase from a small handful to a large herd that today has reduced the number of white-tailed deer to the point of elimination from the area (Case 1938). In British Columbia, Cowan (1947) reported competition to be very severe between mule deer and elk. However, the extent of inter-specific competition of big game has been, for the most part, neglected.

Reports of, and conversations with, members of the Montana Fish and Game Department indicate that elk have all but eliminated white-tailed deer from the Sun River area and that there is a serious conflict between elk and white-tailed deer in Fish Creek (Cooney, R., Couey, F., McDowell, L., and Fish and Game Commission Reports). Yet in these same areas mule deer are apparently thriving side by side with the elk, while on other areas, such as the Sitgraves National Forest, the elk are dominating.

Purchase of key winter ranges by the Montana Fish and Game Department has resulted in the luring of elk to the ranges from nearby ranches. One of these, the Blackfoot-Clearwater game range, purchased in 1949, had a natural winter complement of white-tailed deer, mule deer, and some

elk. With the increased burden of additional elk it will be interesting to watch the outcome.

There is a limited amount of literature available on habitat requirements. Early reports of the Lewis & Clark expedition, around 1805, indicate that the elk inhabited the foothill country (Rush 1932). Recent attempts have been made to re-educate the elk to their historic ranges. Allred (1950) reports the early use of desert range in Wyoming, by elk, and has attempted with some success to encourage use of the Red Desert as winter range. The purchase of land by the Montana Fish and Game Department in the upper foothills of the Sum River country was an attempt to provide historic range for elk and to alleviate damage to nearby ranches.

Today forests are the principal cover types for elk (Cahalane 1938, Rush 1932, West 1941 and others). In Colorada, Ratcliff (1941) found that elk wintered on south and east exposures in yellow pine and bitterbrush types; whereas, deer were found in heavier forests and yet the small clearings and edge produced by fire and streams were essentials of their environment. It would appear that the elk were intruders from the open country.

The most significant aspect of competition is that

of food habit. Robinson (1931), Schwartz (no date), DeNio (1938), Baldwin & Patton (1938), Grimm (1939), Cliff (1939), Mitchell (1941), Gaffney (1941), Carhart (1941), Hill & Harris (1943), Cowan (1947), Buechner (1950), Leopold (1950), and others report the food preferences of deer and elk together or of either species singly. The versatile food habit of elk and the more restricted one of deer implies the possibilities of intensive competition between species on game ranges of limited supply which in this area would relate to the winter ranges of the big game.

The influences of slope, exposure, water, snow conditions and possible social nature of the animal are part of the inter-specific relationships. Mass (1938) listed some general conditions for winter ranges of white-tailed deer and mule deer. Included were some critical snow depths that provide some limitation of mobility. King (1938) stated, in reference to essentials of a game range, that "those factors of the environment . . . the wildlife manager . . . is concerned with can be separated into two groups: first, the essentials, those things that must be present or provided on every range if it is to support any wildlife at all and second, the extranuities, those things that occur on practically every range and must perforce be recognized in the management program although they are not

essential to the productivity of the range. The essentials are: foods, coverts, water resources, juxtaposition, and interspersion." The closest approach to an analysis of the environmental factors associated with winter range of big game is the work of Webb (1948) in New York on the white-tailed deer. His work does not concern itself with competition but is an evaluation of the cover, slope, exposure, and food conditions of a white-tailed deer winter range.

The amount of literature available for use in Western Montana is limited. There is no literature inclusive enough to cover the environmental factors surrounding white-tailed deer, mule deer, and elk. The work on environmental requirements is found almost solely in Webb (1948) and this treats only of the white-tailed deer in the East. The food habit studies show the variation of food habit, but due to the vegetational difference between the regions where the study was made, very little of it can apply.

AREAS STUDIED

A study of environmental characteristics and interspecific competition necessitated the selection of study areas representing the various combinations of animals likely to be encountered.

The possible combinations frequently encountered are:

1. White-tailed deer
2. Mule deer
3. Elk
4. White-tailed deer--mule deer
5. White-tailed deer--elk
6. Mule deer--elk

A white-tailed deer, mule deer, and elk combination is rarely encountered and was, therefore, not considered.

Before selecting the areas to be studied it was necessary to determine the number of areas that could be visited and the degree of intensity of the observations. It was decided that one area would be studied intensively, twenty areas extensively, and one area would be under limited observation.

A study of the Montana Fish and Game Department maps showing winter concentration areas (Pittman-Robertson Quarterly of April-June 1948), provided a means of locating the major areas. A thorough field check, with Frank Gummer of the State Game Department, established more specifically the areas to be studied.

The areas selected are outlined on Figure 1 and the number corresponds with the number preceding each of the following areas:

Intensive Study Area

1. Blackfoot-Clearwater Game Range--all combinations

Extensive Study Areas

Rock Creek Drainage

2. Quigley--mule deer
3. East of Gilbert Creek--white-tailed deer and mule deer
4. Gilbert Creek--white-tailed deer
5. Rock Creek Bridge--white-tailed deer
6. Ranch Creek--mule deer

Clark's Fork Drainage

7. Harvey Creek--mule deer and elk
8. Beavertail Hill--white-tailed deer and mule deer
9. Bonita--white-tailed deer
10. Schwartz Creek--white-tailed deer
11. Turah Creek--white-tailed deer

Blackfoot Drainage

12. Baker Flat--white-tailed deer and elk(early)
13. East Twin Creek--white-tailed deer and elk
14. Gold Creek--white-tailed deer and elk
15. Cap Wallace--elk and mule deer(late)
16. West Twin Creek--elk and mule deer
17. East of Boyd Ranch--mule deer
18. Brown Ranch--mule deer
19. Johnson Gulch--white-tailed deer
20. Potomac--mule deer
21. Dry Cottonwood Creek--elk

Observation Area

22. National Bison Refuge at Moiese--all three species

Figure 1. Areas studied.

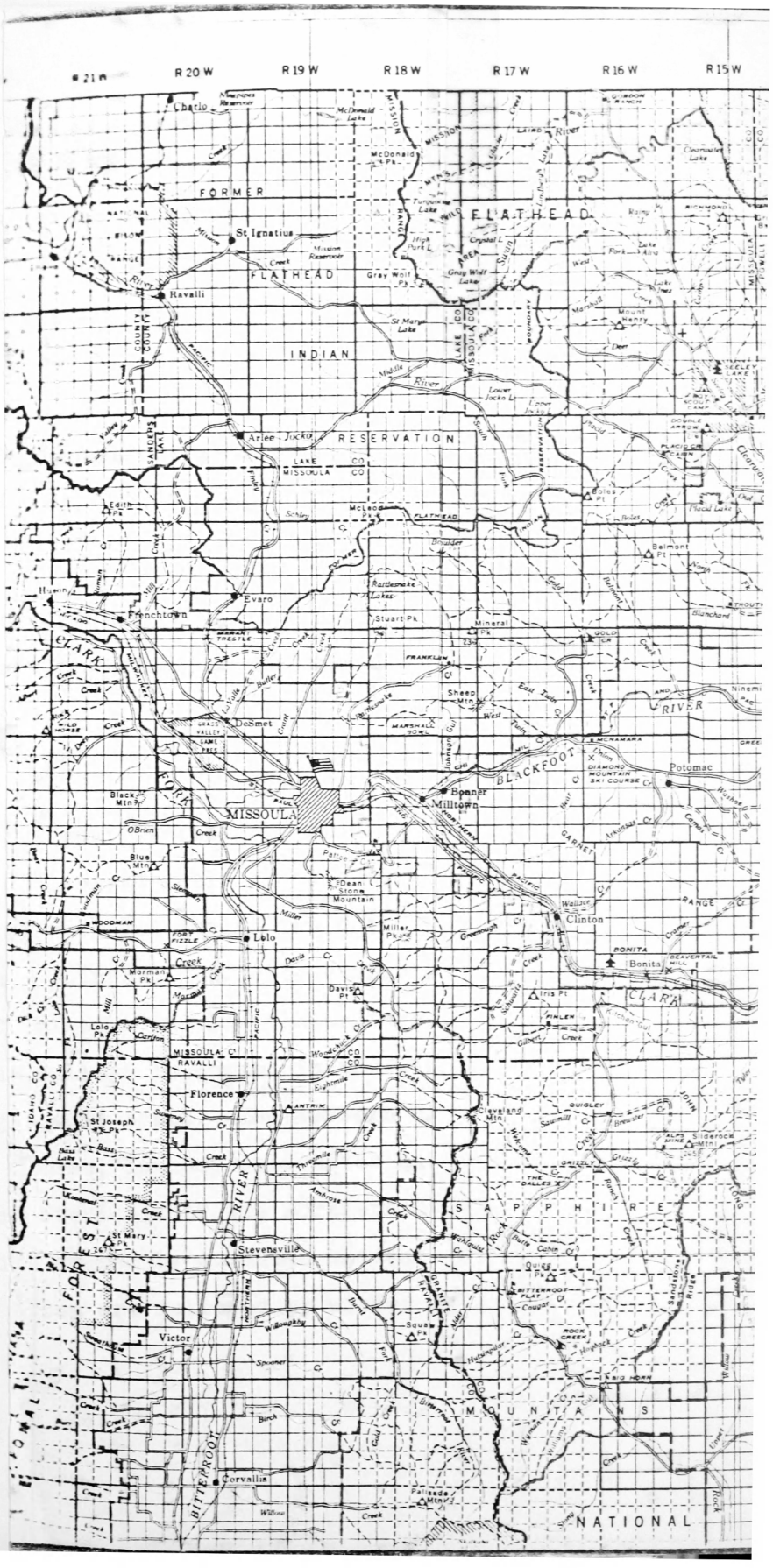
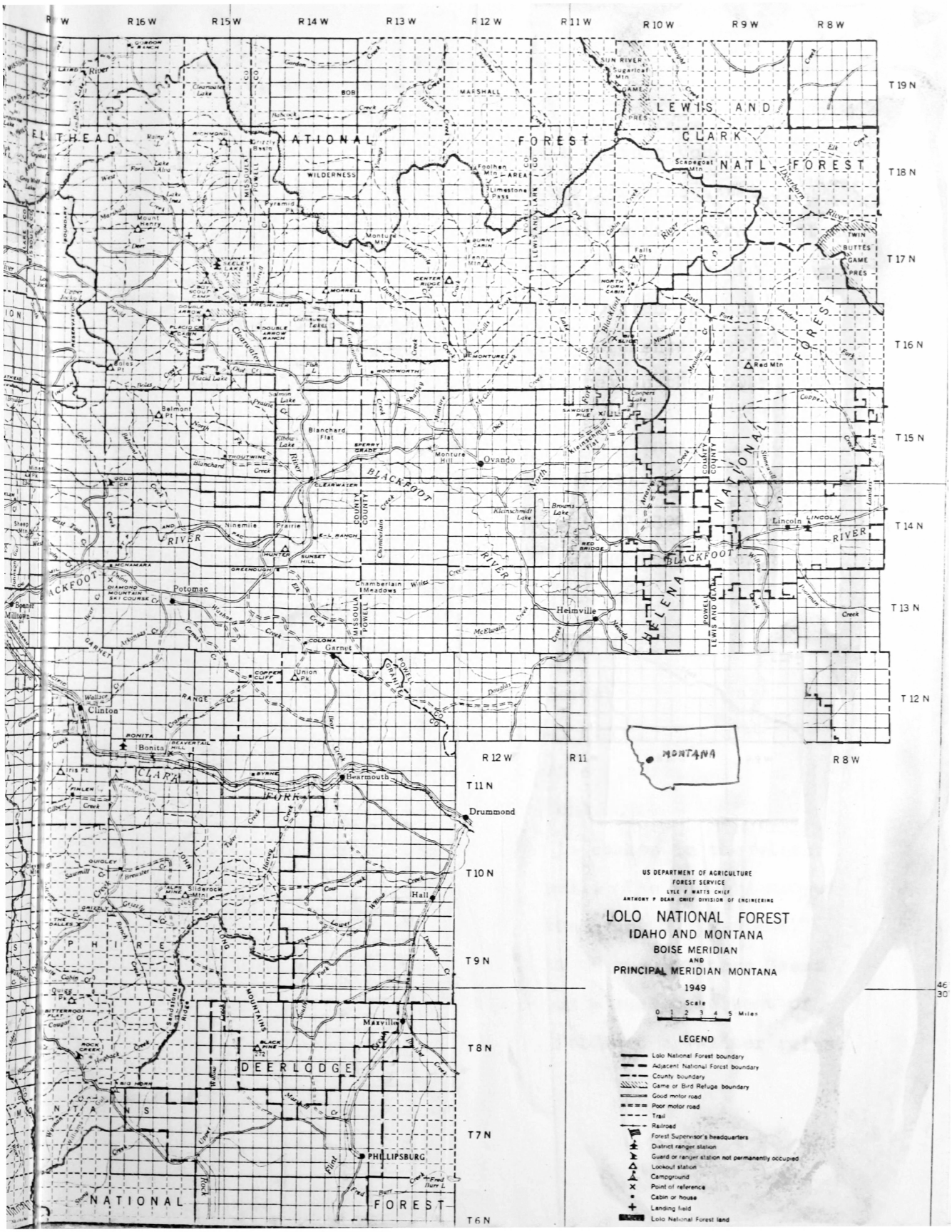


Figure 1. Areas studied.


R 16 W
R 15 W
R 14 W
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R 11 W
R 10 W
R 9 W
R 8 W
T 19 N
T 18 N
T 17 N
T 16 N
T 15 N
T 14 N
T 13 N
T 12 N
T 11 N
T 10 N
T 9 N
T 8 N
T 7 N
T 6 N
LEWIS AND CLARK NATL FOREST
NATIONAL FOREST WILDERNESS
HELENA NATIONAL FOREST
BLACKFOOT RIVER
CLEARWATER
Ovando
Helmville
Potomac
Garnet
Clinton
Bonita
Bearmouth
Drummond
Hall
Maxville
PHILLIPSBURG
DEERLODGE
MISSOULA
POWELL
LEWIS AND CLARK
GRANITE
RANGE
FLATHEAD
SUN RIVER
SCAPEGOAT
BUTTES GAME PRES
MONTANA
US DEPARTMENT OF AGRICULTURE
FOREST SERVICE
LYLE F WATTS CHIEF
ANTHONY P DEAR CHIEF DIVISION OF ENGINEERING
LOLO NATIONAL FOREST
IDAHO AND MONTANA
BOISE MERIDIAN
AND
PRINCIPAL MERIDIAN MONTANA
1949
Scale
0 1 2 3 4 5 Miles
LEGEND
Lolo National Forest boundary
Adjacent National Forest boundary
County boundary
Game or Bird Refuge boundary
Good motor road
Poor motor road
Trail
Railroad
Forest Supervisor's headquarters
District ranger station
Guard or ranger station not permanently occupied
Lookout station
Campground
Point of reference
Cabin or house
Landing field
Lolo National Forest land

Winter concentration areas in western Montana occurred below 6,000 feet and the heavier concentrations below 5,500 feet. These areas lay within the Petran Montane Forest (Pinus-Pseudotsuga Association) at higher wintering levels and in the Palouse Prairie (Agropyron-Festuca Association) at the lower levels (Weaver & Clements 1938). The heaviest concentrations of game occurred in the lower Montane Forest.

The areas studied occur west of the continental divide. The region is characterized by rugged mountains and narrow valleys. Most of the area had been glaciated at one period or another.

The winter climate is characterized by moderate moisture, chinook winds, and considerable cloudiness. The majority of the moisture is received during the fall, winter, and spring seasons. Winters are quite variable with respect to amount of moisture and low temperature. Cold air stagnation in the valleys is common in the winter which may cause a prolonged cold spell. The western slopes do not often receive the sudden, intense cold waves and blowing conditions so characteristic of the Northern Great Plains. The chinook winds, caused by a sudden descent of warm air, are common and often are followed by winter rains.

This combination tends to reduce the snow accumulation at higher elevations and removes the snow at lower elevations (Yearbook of Agriculture 1941).

Climatological data from four stations inclosing the study area is summarized in Tables 1 and 2. There are two stations located close to Ovando; Ovando 1 SW is located one mile southwest of the town and Ovando 7 WNW is located on the Blackfoot-Clearwater game range. Since the latter station has been in operation only a short time it was necessary to fill in the tables with some information from Ovando 1 SW.

Table 1. Precipitation in inches for Western Montana during the period of November 1950 to April 1951.

	Total	Departure from Normal	Greatest Day	Date	Snow, Sleet, Hail		
					Total	Maximum Depth	Date
November-1950							
Drummond 1/	1.33	.81	.39	7	16.4	10	18
Missoula 2/	1.74	.84	.40	17	12.9	5	20
Ovando 1SW 3/	2.38	.84	.50	30	-	-	-
December-1950							
Drummond	.47	-.05	.19	4	5.9	9	7
Missoula	1.11	.16	.43	6	12.3	9	7
Ovando 7WNW 4/	.78	-.13*	.30	6	12.4	20	7
January-1951							
Drummond	.48	-.08	.11	27	5.8	4	28
Missoula	1.08	.23	.27	2	11.6	4	3
Ovando 7WNW	.34	-.07*	.17	17	21.0	20	21
February-1951							
Drummond	.35	-.25	.16	21	5.6	4	1
Missoula	.51	-.29	.20	2	4.8	4	2
Ovando 7WNW	.89	.37*	.33	11	6.0	20	2
March-1951							
Drummond	.62	-.15	.18	5	8.9	8	6
Missoula	.92	.10	.32	6	8.5	7	7
Ovando 7WNW	.42	-.14*	.09	6	17.1	14	16
April-1951							
Drummond	.72	-.17	.62	30	6.5	4	30
Missoula	2.25	1.35	1.65	29	6.1	4	30
Ovando 7WNW	1.64	.18	1.60	30	5.5*	4	1

* Taken from Ovando 1SW
1/ Elevation 4300 feet.
2/ " 3201 "
3/ " 4101 "
4/ " 4000 "

Table 2. Temperature in Farenheit degrees for Western Montana during the period of November 1950 to April 1951.

	Average	Departure from Normal	Highest	Date	Lowest	Date
November-1950						
Drummond	23.2	-7.7	64	4	-18	9
Missoula	29.7	-1.7	58	4	- 1	19
Ovando 1SW	22.9	-6.5	63	4	-16	19
December-1950						
Drummond	24.6	1.2	46	24	-16	5
Missoula	28.7	7.3	46	24	7	5
Ovando 1SW	26.2	6.2	48	23	-23	5
January-1951						
Drummond	14.6	-4.6	46	15	-29	29
Missoula	18.9	.3	47	15	-19	29
Ovando 1SW	10.4	-5.5	42	25	-42	29
February-1951						
Drummond	24.0	2.2	57	10	-25	1
Missoula	29.9	6.1	60	10	-12	1
Ovando 1SW	21.8	2.7	54	11	-36	1
March-1951						
Drummond	22.9	-8.7	56	25	-18	6
Missoula	29.8	-3.7	58	25	- 6	8
Ovando 1SW	21.0	-7.6	50	24	-20	8
April-1951						
Drummond	38.1	-5.2	67	31	- 1	21
Missoula	43.7	-0.2	70	12	14	19
Ovando 1SW	38.5	-1.9	67	26	6	19

METHODS

The presence of animals on a particular range at a certain period is governed by conditions, existing on that range, favorable to the animal. To establish the character of these conditions it was necessary to devise a method of inspection that would provide a coverage of the factors of environment affecting distribution of animals.

The first step required the listing of all possible factors contributing to distribution of deer and elk on winter range. Second, the time of inspection and the size of the area as well as the size of plots within the area had to be considered. Third, a suitable field sheet and a method of analysis had to be provided. Fourth, it was necessary to break these factors down into their various component parts.

The selection of factors of environment affecting distribution were resolved into these five categories.

1. Snow conditions
2. Exposure
3. Topography
4. Cover type
5. Composition and use of forage

I. TIME OF STUDY

Time of inspection varied with the degree of inten-

sity of the observations. On extensively studied areas an early winter and a late winter visit were scheduled. The early winter visit would obtain conditions and distribution of animals shortly after they arrived on their winter range. January was selected as representative of early winter conditions. The late winter inspection was scheduled for March. This would provide a lapse of two months time between the two visits, thus allowing intervening climatic and environmental conditions to exert their influence on the animals.

On the intensive study area the visits were scheduled at monthly intervals. Due to financial limitations the February visit had to be canceled. The first visit in November checked the past summer and fall use by pellet group checks. Subsequent visits the first weekend in December, January, and March checked respectively pre-winter, early winter, and late winter distribution and use. On these three visits and the two visits to extensive areas, environmental data and distribution by tracks were recorded on Form C-1 (Figure 2).

II. FIELD SHEET AND MISCELLANEOUS

A special form, called Form C-1, was prepared for the field work. One sheet covers eight plots (equivalent

Form C-1

Area _____

Sheet Number ___ Date _____ Examiner _____ Sec. ____ Tws. ____ Range ____

Plots	1			2			3			4			5			6			7			8		
Snow conditions																								
Exposure																								
Topography																								
Cover type																								
Tracks) Deer																								
Droppings)																								
Tracks) Elk																								
Droppings)																								
Animals seen																								
Plant Species	Den	Yld	Use	Den	Yld	Use	Den	Yld	Use	Den	Yld	Use	Den	Yld	Use	Den	Yld	Use	Den	Yld	Use	Den	Yld	Use

Instructions for use

Plots: 5 feet by 100 feet.

Snow Conditions: Measure depth in inches. Record this additional information - soft (dry or mushy), crusted (able to sustain weight of animal), Blowing, may be used in conjunction with the above situations.

Exposure: North, south, east, west or level and any variation between, i.e., northeast, etc.

Topography: Drainage (draw-up to 25 feet wide; bottom- 25 feet to 500 feet; valley- 500 feet or more), ridge (wide- over 50 feet; narrow- less than 50 feet), slope in percent, broken (rock outcropping or ledges, heavy windfalls etc.) and rolling country.

Cover type: Observe the general cover type in which the plot occurs, do not record the trees found on the plot as the cover type but look at the adjacent areas. However, do not observe other types. Use the following types and symbols to designate them.

Meadow(cultivated land)--Meadow	Douglas fir-Larch--Pta Loc
Willow-Alder--Salix-Ate	Upland browse--Dominant species
Grassland -- List dominant grass	Lodge pole --Pco
Yellow pine-grassland--Ppo-dominant grass	Sagebrush --Atr
Y.pine-Douglas fir --Ppo-Pta	Bitter brush-Juniper--Ptr-Jsc
Y.pine-D.fir-Larch --Ppo-Pta-Loc	Spruce --Ppu

Where more than one species odcurs list according to abundance, the most abundant first. These types are the dominant species.

Tracks & Droppings: Record all sets of tracks or droppings encountered along a 5 foot wide strip. These will be recorded upon stopping at the next plot.

Animals seen: Record any big game animals seen, attempt to age and sex the animal i.e., buck, doe, fawn, yearling, bull, cow, calf, etc. If the animals are in another drainage or across a valley make a note indicating approximate distance and direction.

Blank Spaces: Record any additional information such as pawing for food, dead animals, predators seen, etc.

Plant Species: If a plant is not identified give it a number and bring in a sample of the plant. Record all information concerning the plant against this number.

Density: Record density in square feet. This is a coverage of the crown projecte to ahorizontal plane.

Yield: Ocular estimate of weight of annual growth in ounces.

Use: Both yield and use figures will be measured to the following limits. Seven feet for deer and 9 feet high for elk, and on joint use areas use 9 feet. Ocular estimate of weight of plant used, by animals, in ounces.

to a half mile) and provides space for recording data on environmental factors and miscellaneous notes. Instructions on the reverse side were prepared for use of students assisting in the work on the intensive area.

Preliminary studies in November on the size and frequency of plots indicated that a one hundred foot by five foot plot, taken at five chain intervals, provided an adequate measure of the area. The length and direction of the lines were determined from a map of the winter area. The lines were selected to cover all of the various topographic features. The length of line varied with the conditions existing on each area. Vegetative data, except cover type, were taken on the five hundred square foot plot. Slope, exposure, and snow depth were taken as an average of the five chain distance. The actual number of tracks crossing this five chain distance was also recorded. The cover type, however, required an examination of the general area to determine the dominant species present.

The species of animal using the area were checked by pellet counts, track counts and actual observation. The pellet counts were used only as a check on distribution in the November inspection of the intensive area. Track counts, supplemented by other observations were used as

distribution checks on all visits, except the one in November. Deer and elk could readily be distinquished by tracks but an attempt to establish some criteria for differentiating between mule deer and white-tailed deer tracks proved futile. Only when the mule deer bounded could any difference be detected. Therefore, it was necessary to make special observation trips to determine the species of deer using an area. Fortunately all areas were satisfactorily checked and none had to be discarded for lack of information on species of animals using them. Supporting information was also obtained from Fish and Game Department men, Forest Service men, and local ranchers working in the areas.

III. SNOW CONDITIONS

The depth of snow was measured to the nearest inch. Other factors such as blowing, soft, and crusted were considered. The crusting of snow was very important to the availability of forage. Crusted conditions were determined by the inability of animals to penetrate the frozen surface.

IV. EXPOSURE

The direction the slope faced was taken to the nearest cardinal direction or midpoint between two cardinal directions, i.e. north, northeast, east, etc. A ninth

category of level was added, this category includes rolling country. The exposure was determined by a cruiser compass carried by the observer. All compasses used were hand compasses of good quality.

V. TOPOGRAPHY

The term as used here covers drainages, ridges, broken country, rolling country, and slope. Drainages consisted of three categories: (1) draw--up to 25 feet wide, (2) bottom--25 feet to 500 feet wide, and (3) valley--500 feet and over. Ridges were classed as wide--over fifty feet, and narrow--less than fifty feet wide. Broken country was recorded as rock ledges, talus slopes, etc. Slope was taken by a per cent Abney and recorded as an actual number and slope classes were later established for analysis of data.

VI. COVER TYPE

Cover type was based on the dominant single species or group of species in a five acre area. No density classes or sub-dominant classes were established. The following types were used:

1. Meadow: cultivated land or pastures
2. Willow-Alder: type found along margins of streams
3. Grassland: referred to as grass only, not by species
4. Pine-Grass: ponderosa pine and grass (any species)
5. Pine-Fir: ponderosa pine and Douglas fir

6. Pine-Fir-Larch: ponderosa pine, Douglas fir and western larch
7. Fir-Larch: Douglas fir and western larch
8. Fir: Douglas fir
9. Upland browse: two dominant species
10. Spruce: englemann spruce
11. Lodgepole: lodgepole pine 70 per cent of dominants

The scientific and common names of the above type species were taken from Kelsey's and Dayton's (1942) "Standardized Plant Names." They are as follows:

Common Name	Scientific Name
Alder	Alnus tenuifolia
Douglas Fir	Pseudotsuga taxifolia
Englemann Spruce	Picea englemannii
Lodgepole Pine	Pinus contorta
Western Larch	Larix occidentalis
Willow	Salix spp.
Ponderosa Pine	Pinus ponderosa

VII. COMPOSITION AND USE OF FORAGE

The ocular estimate by weight method proposed by Pechanec and Pickford (1937) was selected for an analysis of forage. This method requires a preliminary schooling and constant checking to keep the eye trained for estimating. It offers a rapid yet accurate method of taking composition and use data. A scale and paper bag were carried to check the observations at frequent intervals by clipping and weighing. Density estimates were taken to a square foot and weight to a tenth of an ounce.

Limits of availability were established in this study

at a seven feet height for deer, and nine feet for elk. In case of dense clusters of browse only peripheral areas were measured. Pawing for food, riding down of brush, breakage and any other such observations were recorded.

VIII. ANALYSIS OF DATA

The most satisfactory method of analyzing the data would be to record the data on punch cards. Since financial limitations prevented this approach an alternate method was provided. It required the breakdown of slope and snow depth into classes. Data from the plots was recorded on a form similiar to that in appendix (Figure 22).

Vegetative data were compiled by listing and totaling the measurements. This gave the composition in square feet as well as the yield and use of the species. With this information the following form heading was completed.

Species	Density in sq. feet	Per cent Composition 1/	Annual Yield	Use	Ave. Use % per plant by species 2/	% Food Habit 3/

1/ Per cent Composition = $\frac{\text{Each species density in square feet}}{\text{Total for all species density in square feet}}$

2/ Average Use per cent per plant by species = sum of $\frac{\text{Utilized weight of each plant}}{\text{Total available weight of each plant before browsing}}$ / Number of plants in sample

3/ Per cent Food Habit = $\frac{\text{Total utilized weight of a species}}{\text{Total utilized weight of all species}}$

The data of the various areas was then grouped according to the animals or combinations of animals using the area. The values were then totaled and averaged. For example, the correlation of tracks to animal use of slope was first based on the percentage of all tracks occuring on the various slope classes. This was not satisfactory because any slope class having a larger number of observations would tend to give that particular class a higher value than actually occured. Therefore, tracks per five chains or 330 feet were calculated. This method gave a direct measure of use because all figures were based on the same linear area and any slope class with more observations than the others, would not affect the comparison in any manner.

RESULTS

I. DISTRIBUTION PATTERN

The big game species show very distinct seasonal distribution patterns. Within the seasonal patterns smaller local movements occur. The white-tailed deer, generally considered as animals with low mobility (Leopold 1948), migrate approximately twenty-five miles from the Swan Range and upper Clearwater valley to the Blackfoot-Clearwater Game Range and other winter areas along the Blackfoot river. After they arrive on the winter range there are local movements dictated by the pressure of the environment as the winter progresses. The mule deer and elk show similiar mobility patterns. The local movements of these animals are shown on Figures number 3, 4, 5, and 6. Figure number 7 is a cover map of the same area.

From general observations the white-tailed deer moved to the southern and western slopes early in the winter and concentrated in the ponderosa pine types. Mule deer were slower in their movements to the southern exposures and they concentrated more in the Douglas fir types. Elk used all exposures throughout the winter and they showed no distinct preference for cover types. This aspect of the problem will be discussed more completely later in this report.

Figure 3. November fourth and fifth distribution on the Blackfoot-Clearwater Game Range.

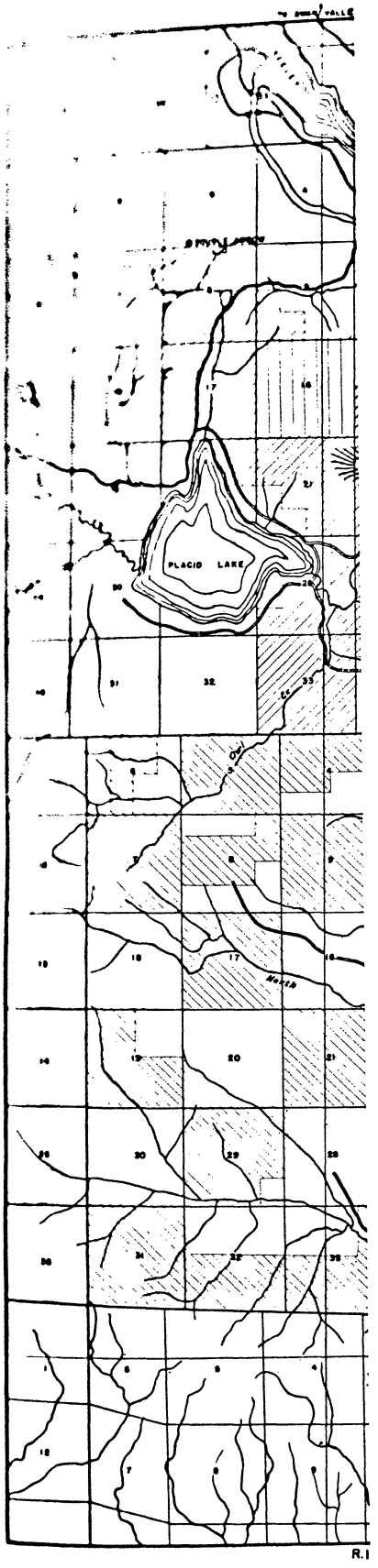
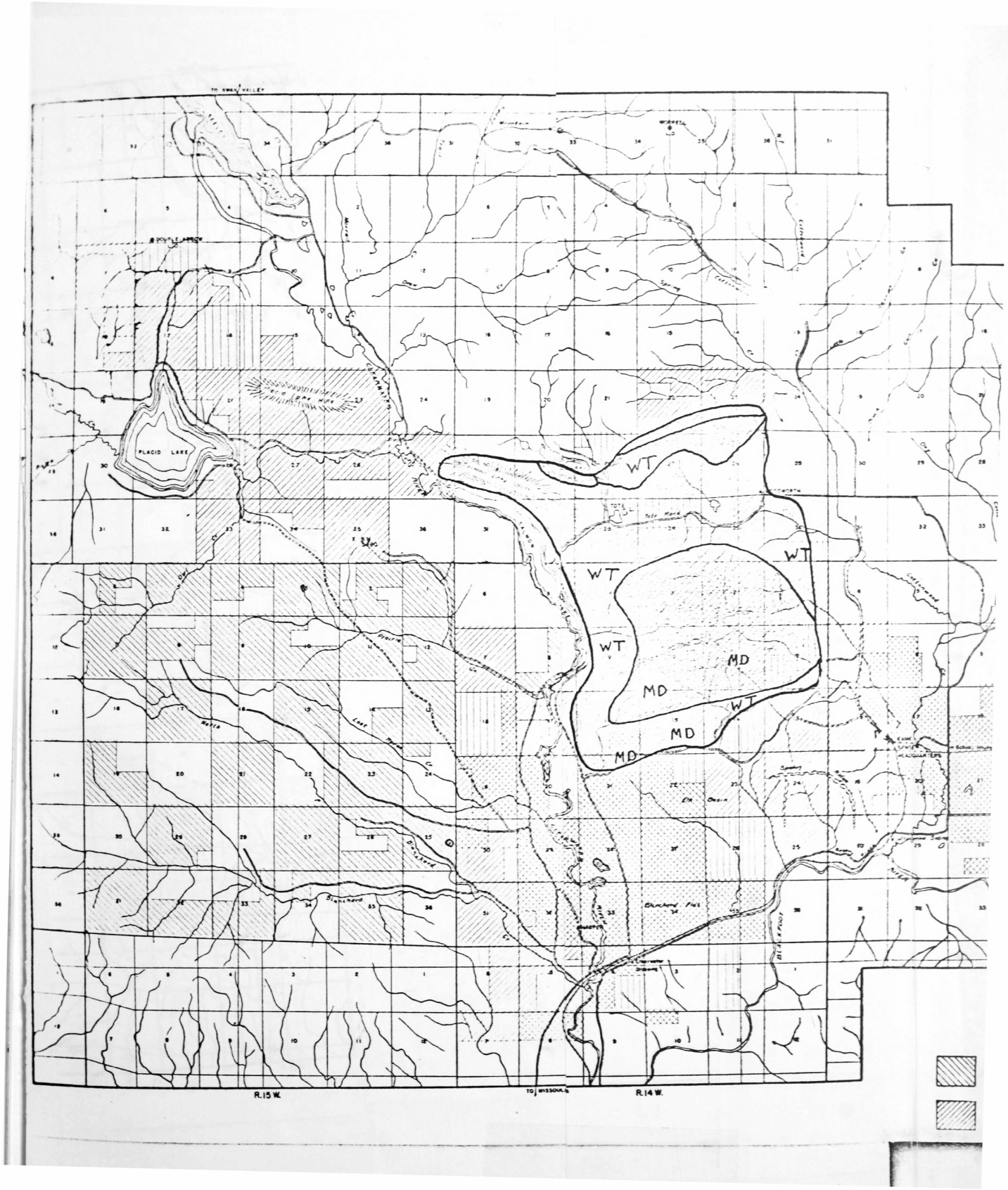
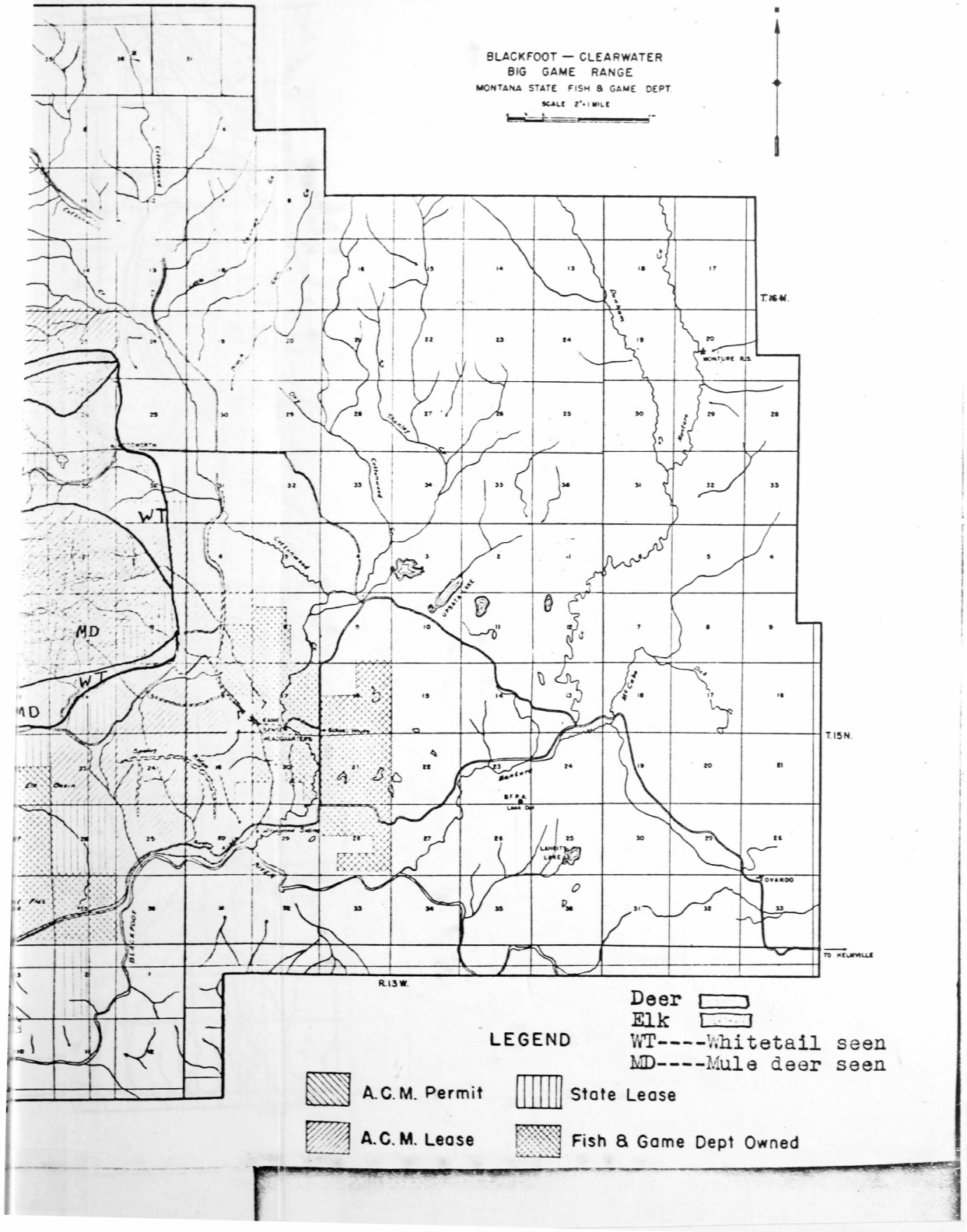
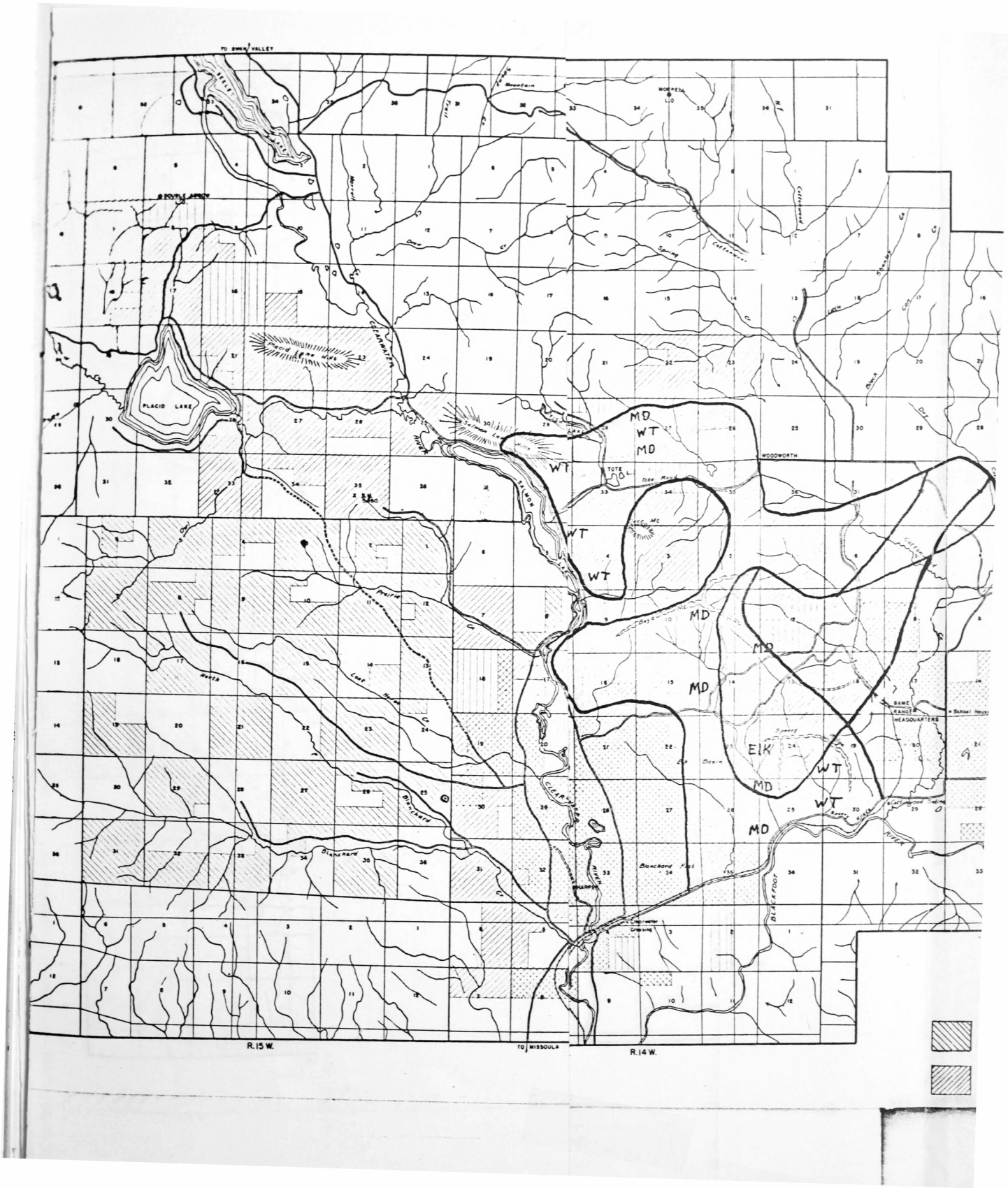


Figure 4. December second and third distribut
on the Blackfoot-Clearwater Game R


PLACID LAKE
WT
WT
WT
WT
MD
MD
MD
MD
R.15 W.
R.14 W.

November 4 and 5, 1950




TO SWAN VALLEY
PLACID LAKE
CLEARWATER
SALMON
WOODWORTH
MD
WT
EIK
BLACKFOOT
R.15 W.
R.14 W.
TO MISSOULA

December 2 and 3, 1950

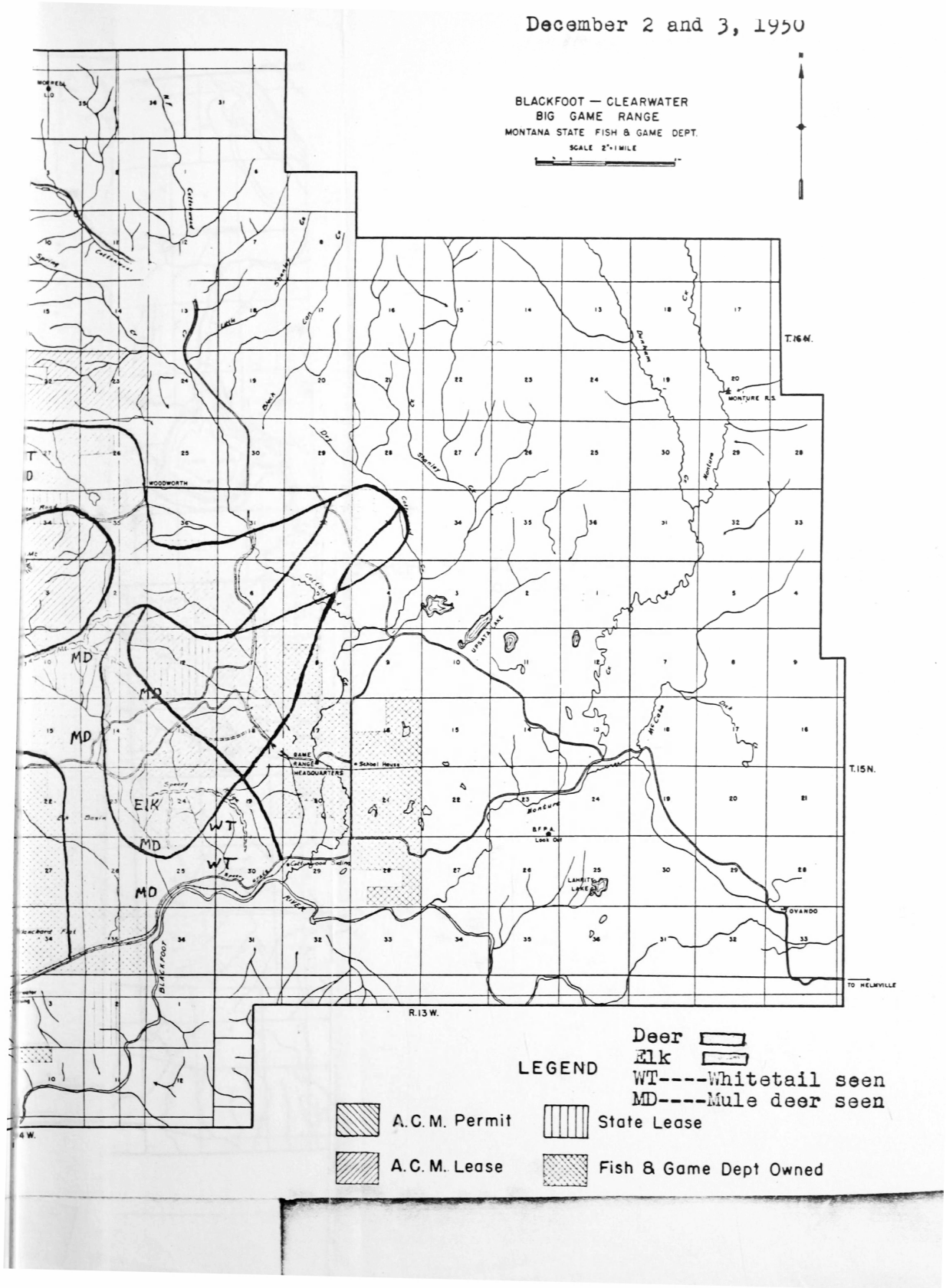
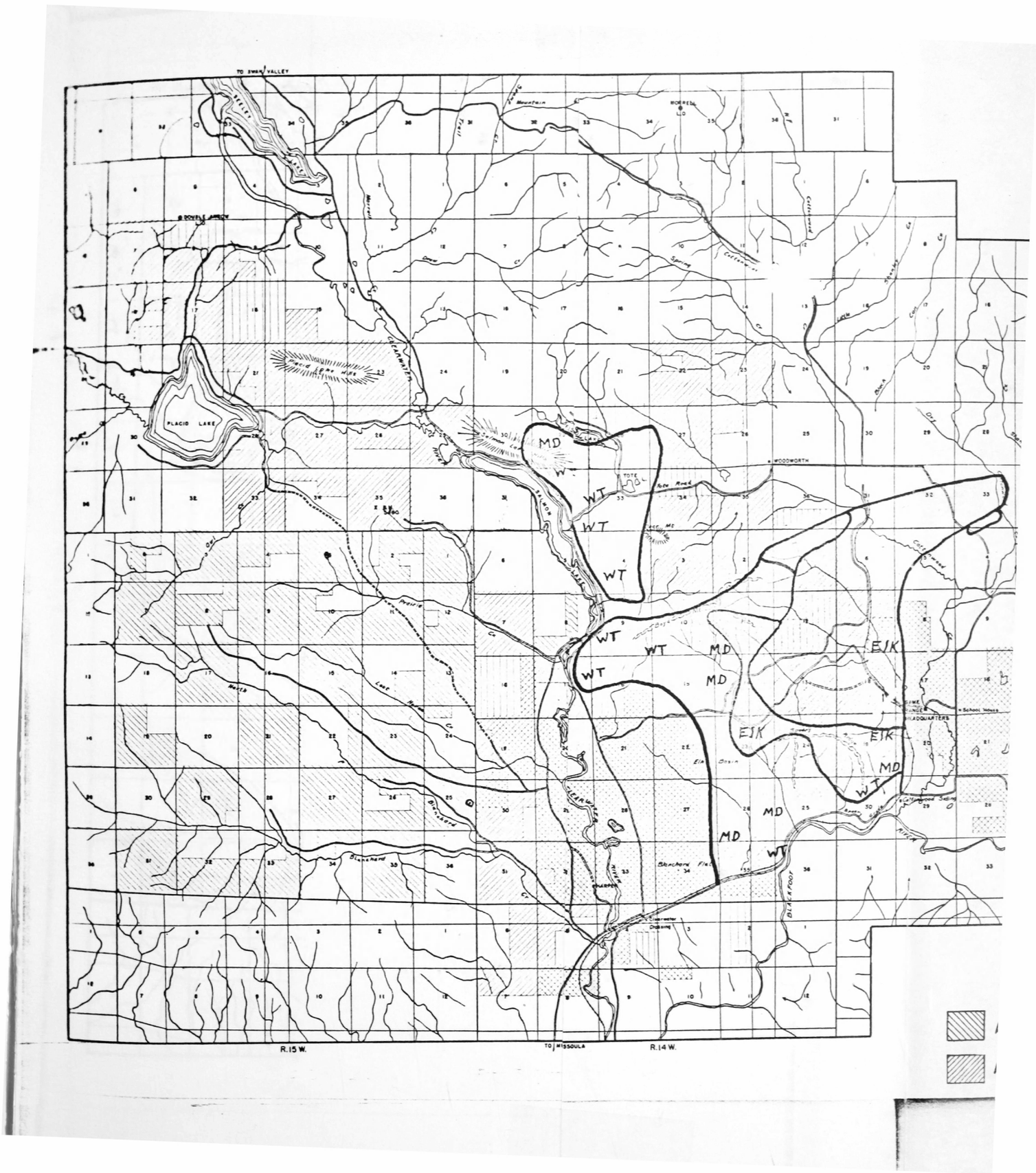
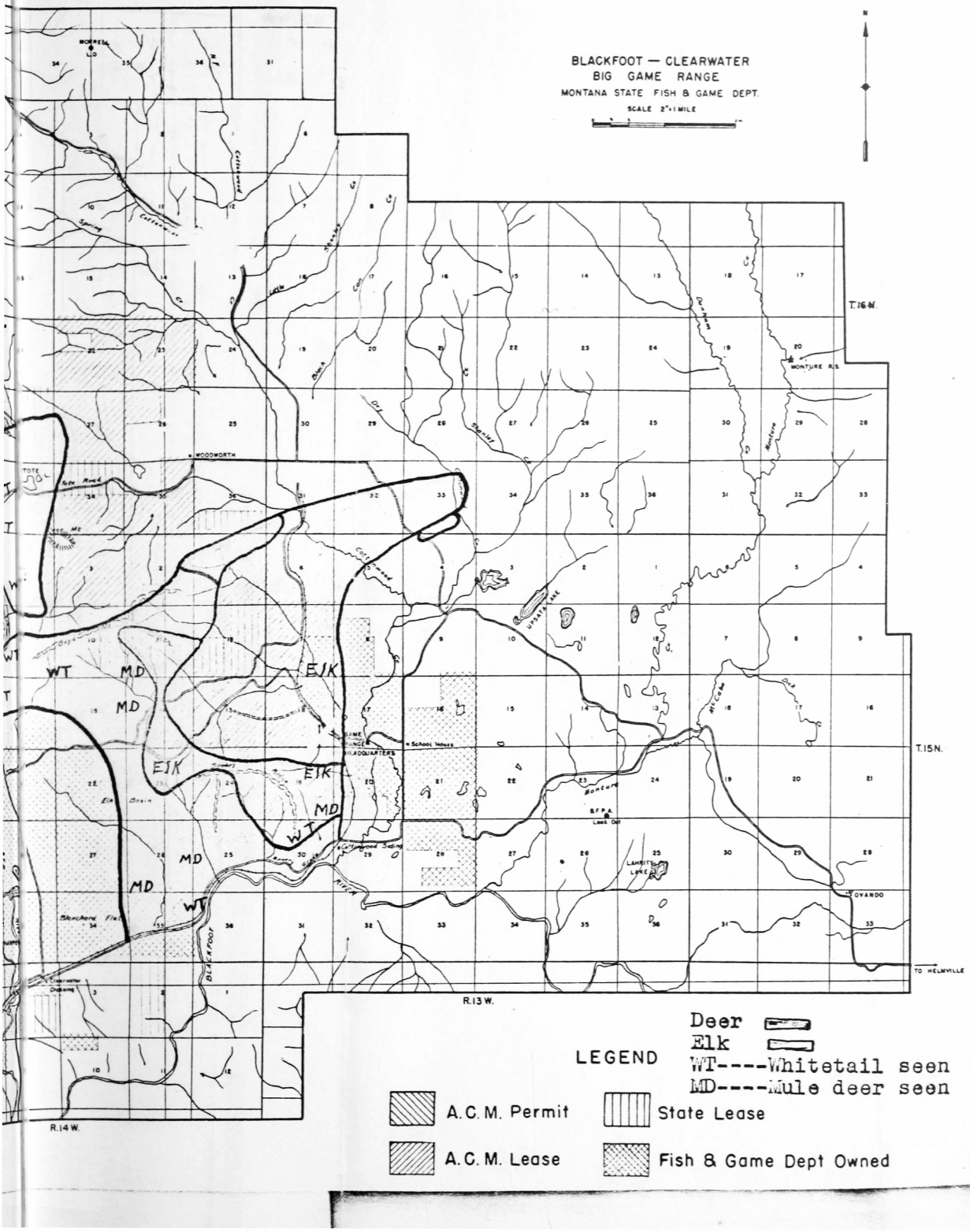


Figure 5. January sixth and seventh distribut
on the Blackfoot-Clearwater Game Ra


TO SWAN VALLEY
PLACID LAKE
WOODWORTH
MD
WT
EJK
TO MISSOULA
R.15 W.
R.14 W.

January 6 and 7, 1951



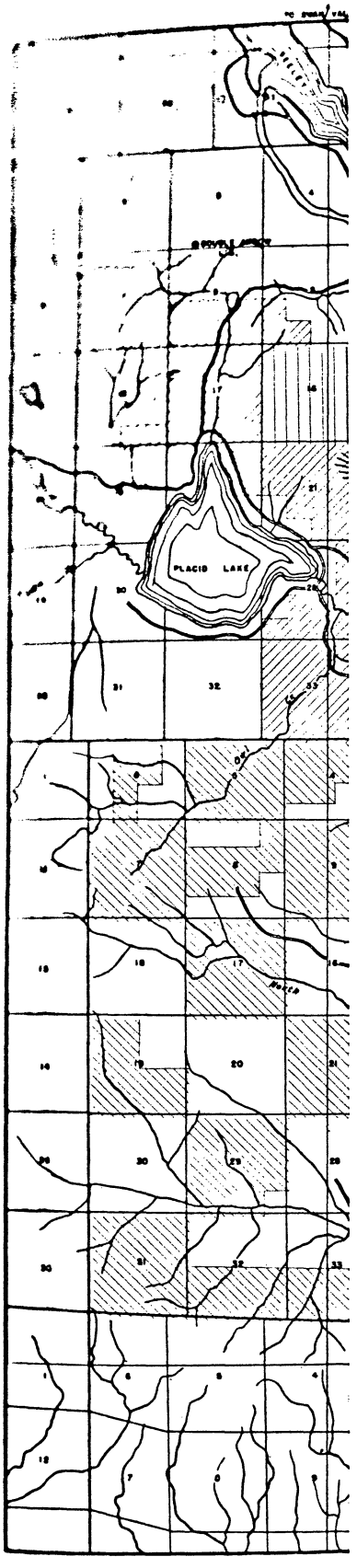
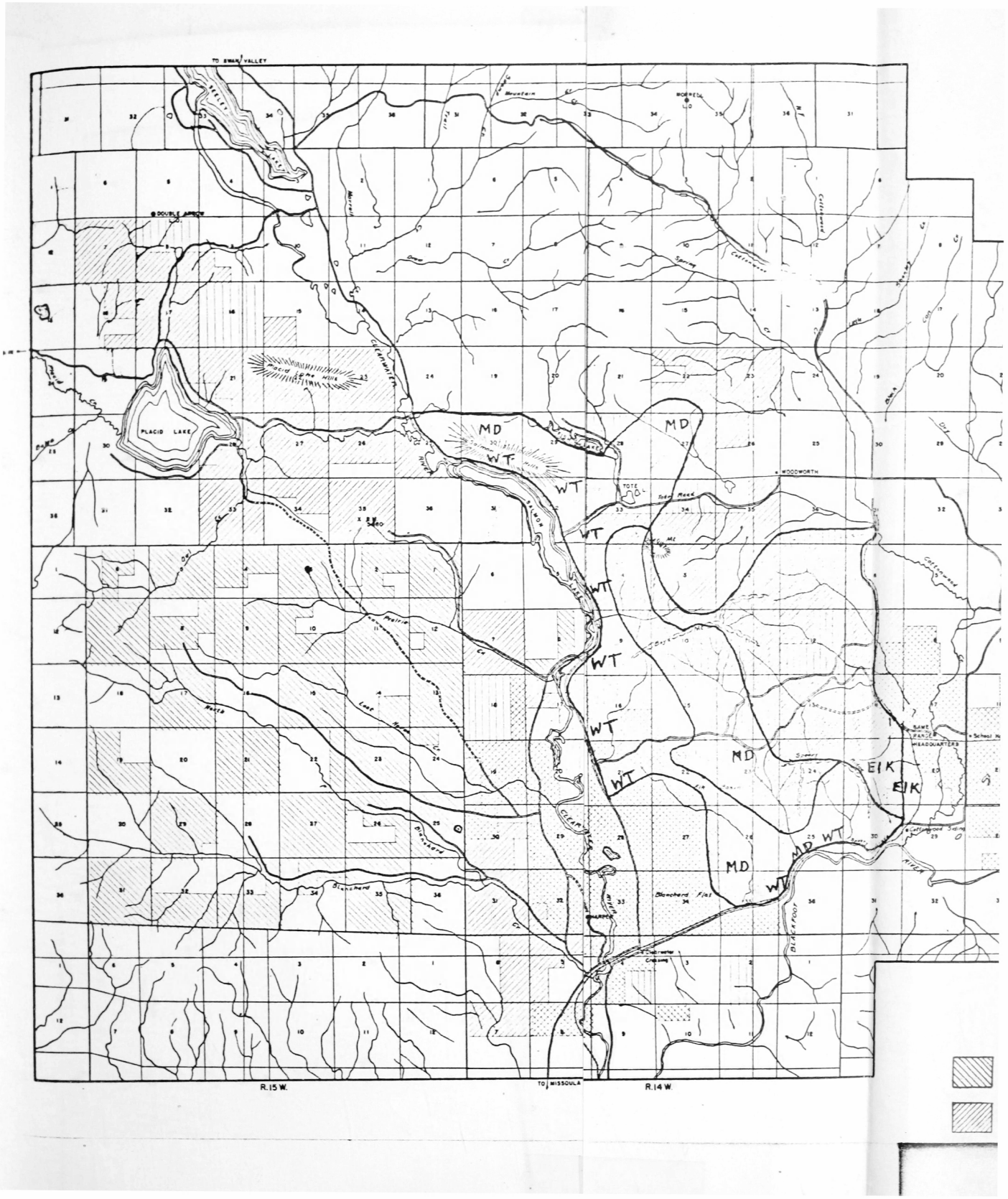
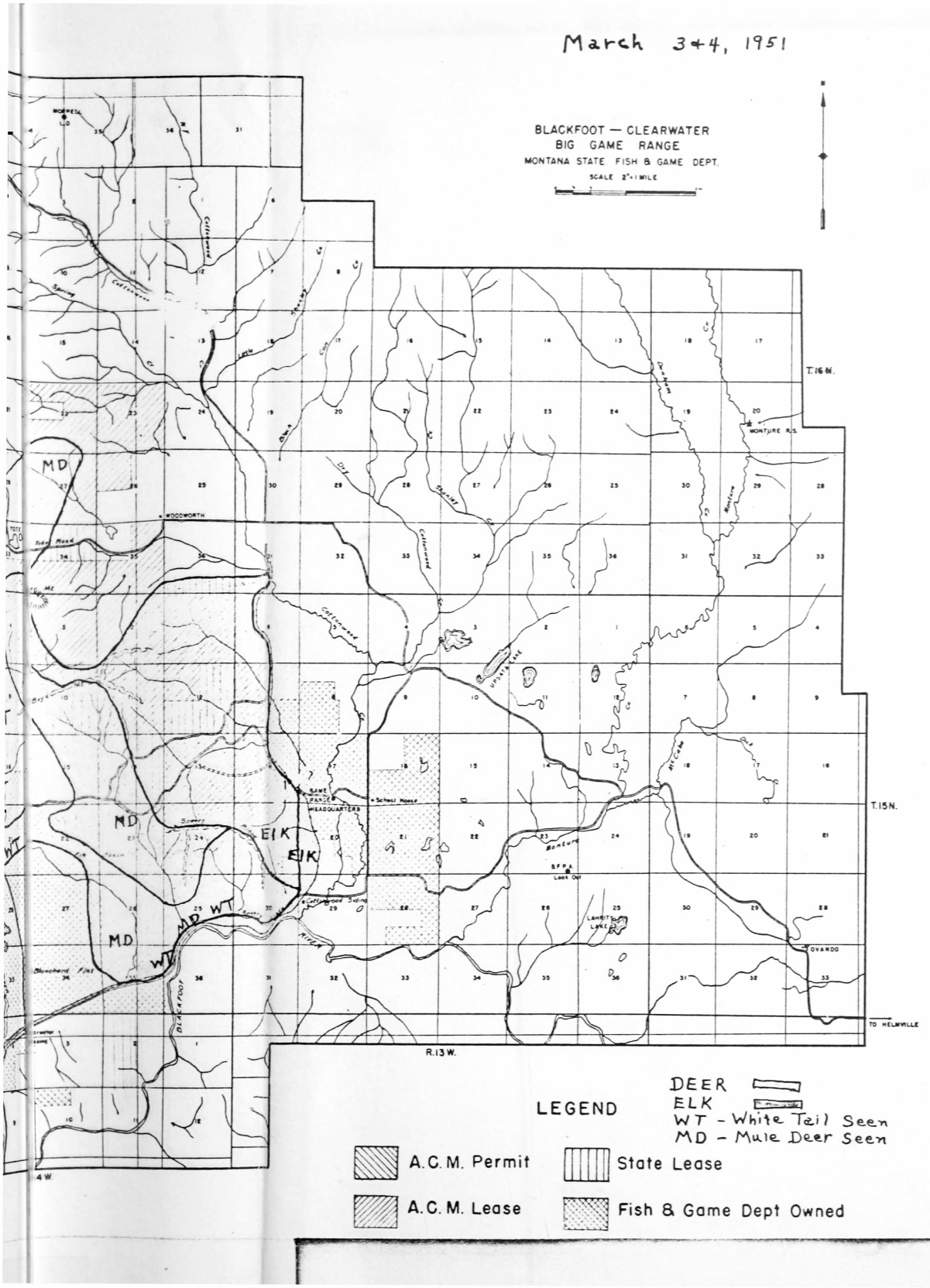


Figure 6. March third and fourth distribution on Blackfoot-Clearwater Game Range.


TO SWAN VALLEY
DOUBLE ARROW
PLACID LAKE
WOODWORTH
TOTE
MD
WT
EIK
R.15 W.
TO MISSOULA
R.14 W.

March 3+4, 1951



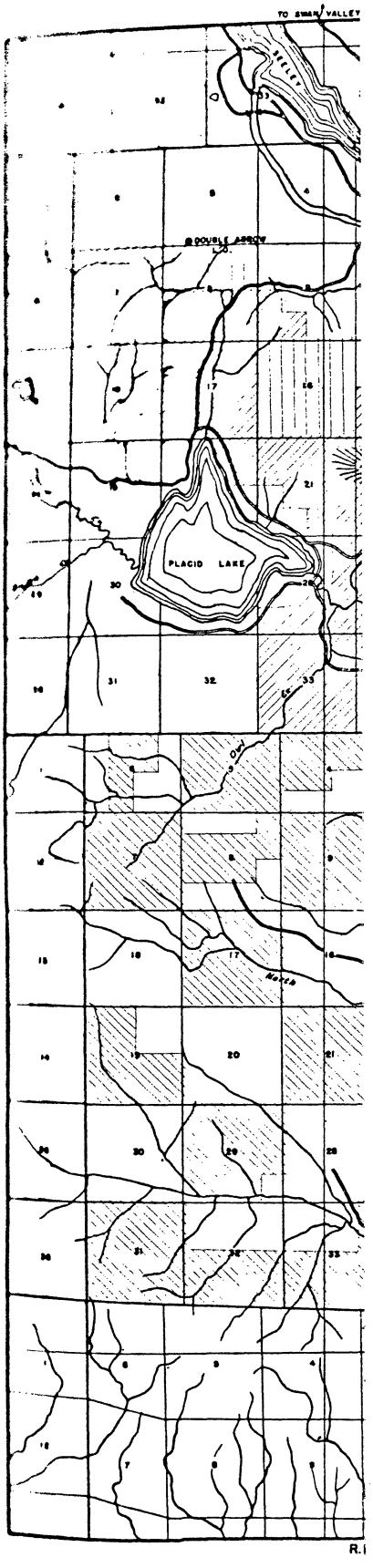
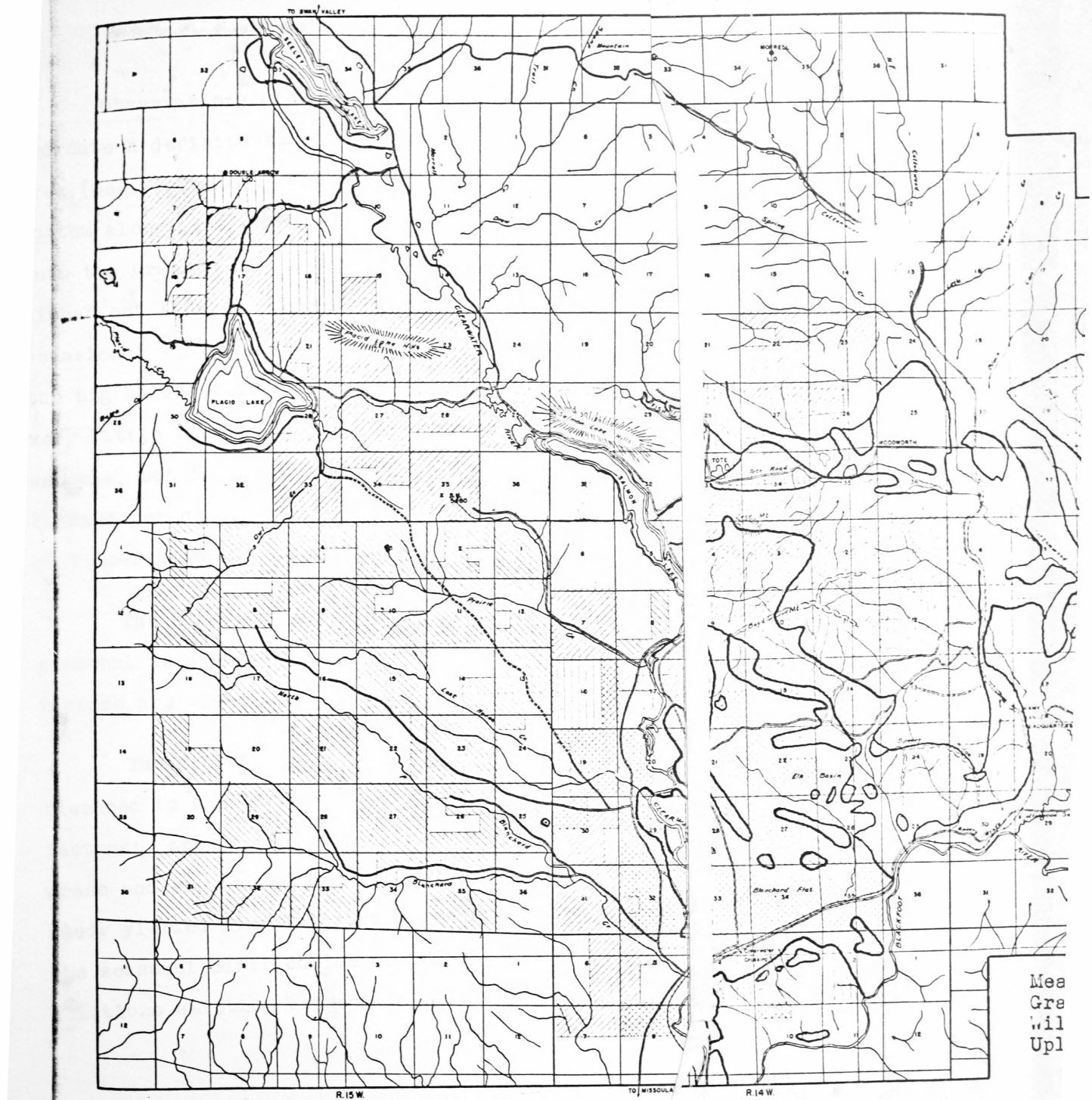
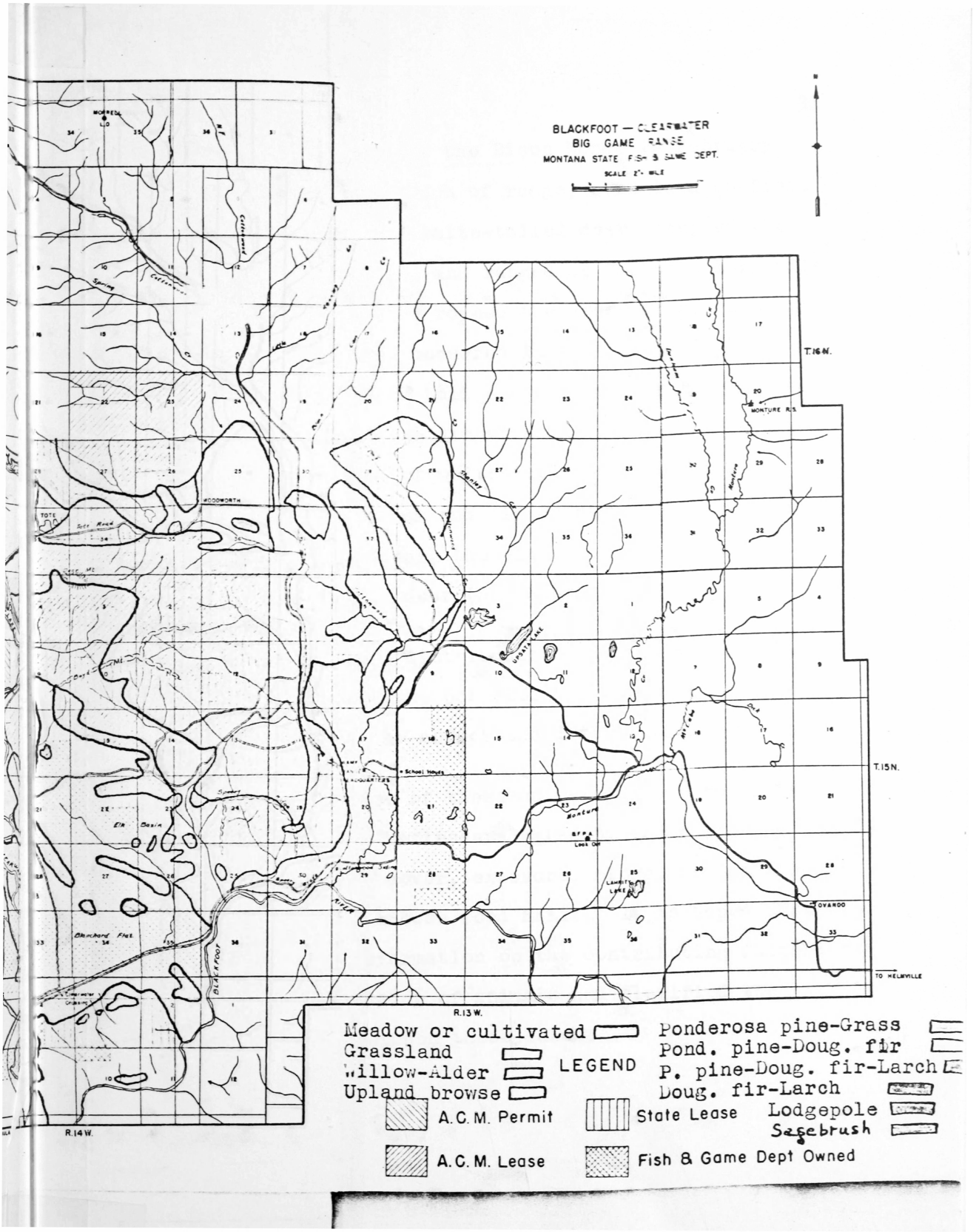


Figure 7. Cover type map of Blackfoot-Cle Game Range.


TO SWAN VALLEY
DOUBLE ARROW
PLACID LAKE
Placid Lake Mts.
Placid Lake Creek
Clearwater River
Salmon Lake
Salmon Lake Mts.
Salmon Lake Creek
Prairie
Prairie Creek
Nevada
Lake
Nevada Creek
Blanchard
Blanchard Creek
Blanchard Flat
Elk Basin
Elk Creek
Woodworth
Dry Rock
Summit
Mountain
Spring
Creek
R.15 W.
TO MISSOULA
R.14 W.


BLACKFOOT — CLEARWATER
BIG GAME RANGE
MONTANA STATE F.S. & GAME DEPT.
SCALE 2" = 1 MILE
N
T.16N.
T.15N.
R.14W.
R.13W.
TO HELMVILLE
MONTURE R.S.
OVANDO
WOODWORTH
TOTE
Elk Basin
Blanchard Flat
School House
Look Out
LEGEND
Meadow or cultivated
Grassland
Willow-Alder
Upland browse
A.C.M. Permit
A.C.M. Lease
State Lease
Fish & Game Dept Owned
Ponderosa pine-Grass
Pond. pine-Doug. fir
P. pine-Doug. fir-Larch
Doug. fir-Larch
Lodgepole
Sagebrush

Observations made at the Bison Range in February indicate a definite selection of range, even in a confined area (See Figure 8). The white-tailed deer occupied the bottom along Mission River and ranged as far as a half mile into the grass. Mule deer roamed the grass areas using the timber but little. They occurred in the bottom as an occasional visitor. Four bull elk wintered in the bottom but the big herds utilized the timber and grassland. There was very little overlapping of white-tailed deer and other animals, but the mule deer and elk overlapped almost one hundred per cent. However, the elk made more frequent use of timber than the mule deer (See Photograph 5).

The existence of distribution patterns within the seasonal area suggests the possibility that environmental factors are operating to affect the distribution pattern.

The distribution of these animals appear to be influenced to a greater or lesser degree by the following factors: snow depth, cover, exposure, slope, composition of grass and browse and browse food habit. It is hoped that the study yielded some information on the contributing factors to the seasonal distribution of animals and clarified the relations existing between these animals.

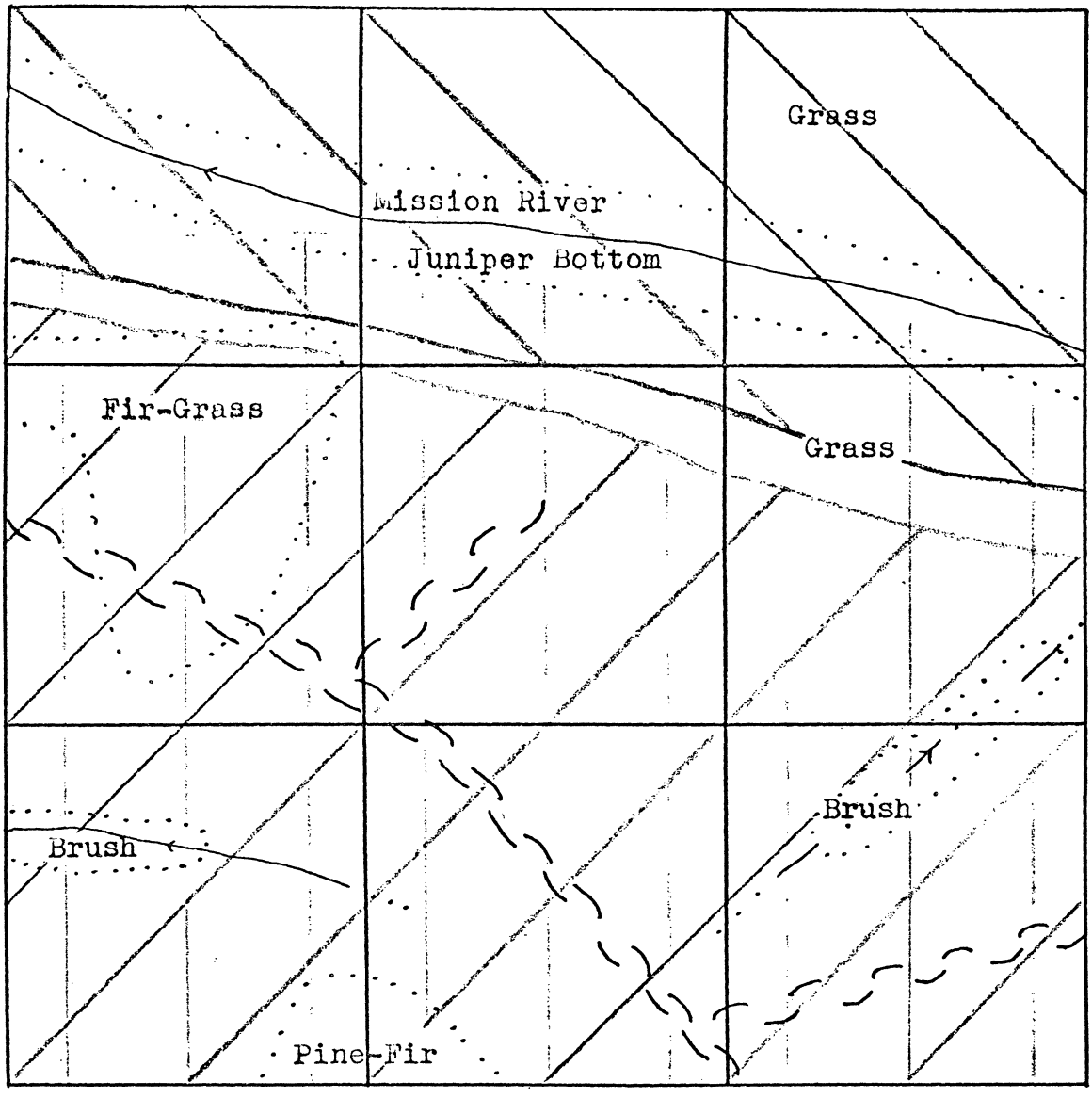


Figure 8. Distribution and cover map of the National Bison Range at Moiese. Northeast portion shown above.

Legend

···· type line
~~ ridge
→ stream
—— white-tailed deer
—— muledeer
—— elk

Scale: 2 inches equal 1 mile.

II. SNOW DEPTH FACTOR

The accumulation of snow on intermediate ranges may force the animals onto their winter range. The term, winter range, is arbitrary because its limits are set by snow depth. During open winters the winter range may include part of the spring-fall range; whereas, during severe winters the animals may be confined to very restricted areas.

Extensive Areas. The average of the early and late winter observations are shown in Figure 9. The white-tailed deer show a definite preference for areas with snow depth of less than twelve to fifteen inches. The observations in deeper snow were mainly from trails crossing draws or trails in the bottom leading to water. In deep snow the white-tailed deer used trails and there were very few individual tracks. This implies an aversion to deep snow.

In the interpretation of the snow depth graphs (See Figure 9) and other tables following that have as their ordinate, tracks per 330 feet, two things should be remembered: first, that there were not the same number of animals of each species and second, the time of observation after a fresh snow varied. Therefore, each curve should be judged by its trend rather than its frequency, this holds

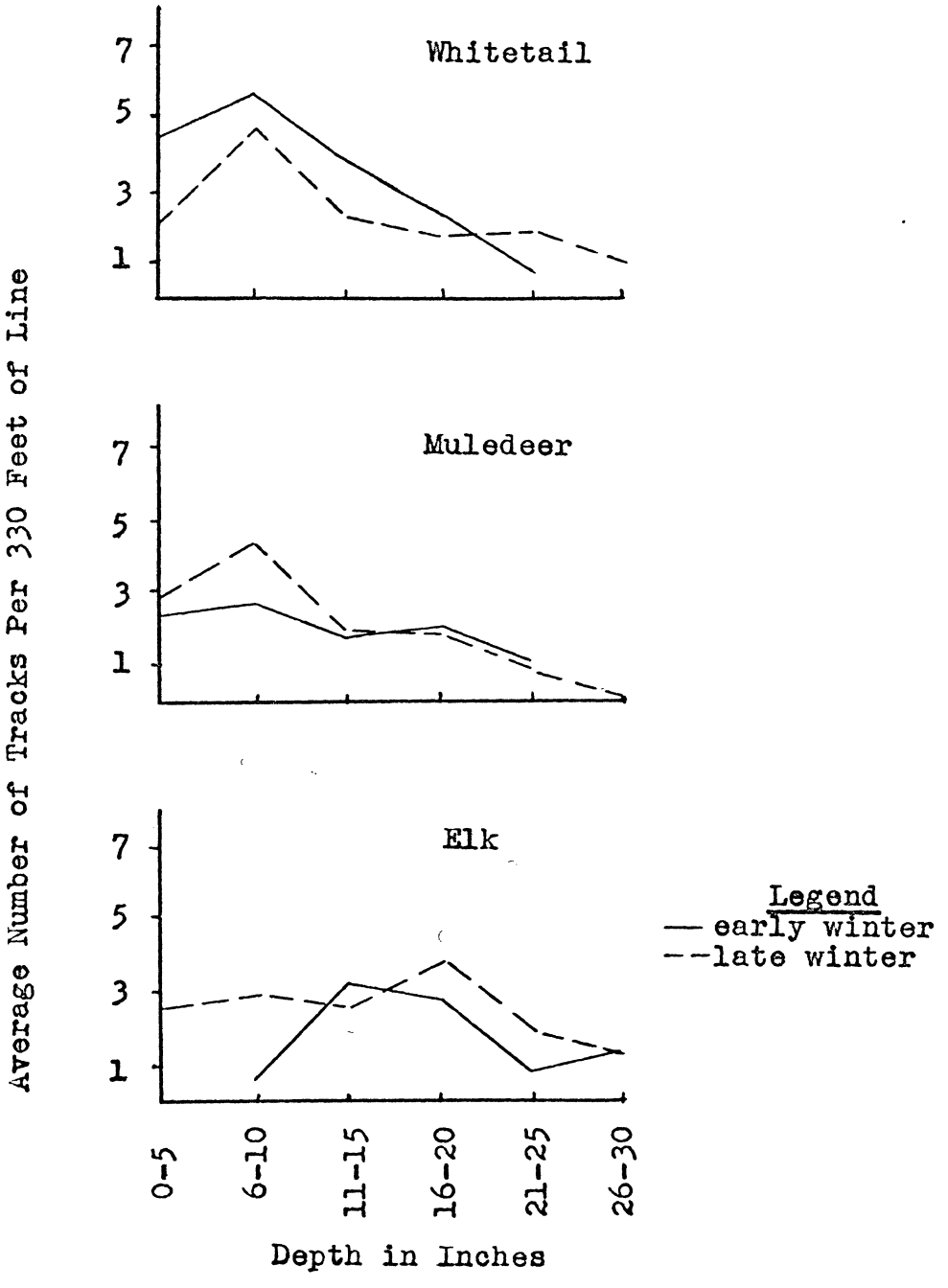


Figure 9. Tracks in relation to snow depth on extensive areas.

true, particularly, for comparisons of early and late winter observations on the same area. In other words, the curves presented should be evaluated primarily on the relative differences between factor classes.

Mule deer in early winter showed a preference for regions where the snow depth was between zero and fifteen inches, but in late winter they were quite similiar to white-tailed deer in their selection. However, the use of deeper snow areas was not related to crossing draws and going to water, as was the case of white-tailed deer, but rather to the use of higher slopes and rolling country. There was also a pattern of individual trails crossing through the deeper snow in spite of the fact that the mule deer were observed to be more gregarious than the white-tailed deer.

Elk were able to travel and forage in quite deep snow. Their greatest concentrations occurred at fifteen to twenty inches and they showed proportionately greater use of deeper snow than the deer.

Intensive Area. Three observations representing pre-winter, early winter, and late winter are shown in Figure 10. The white-tailed deer show the same pattern as the extensive areas, with a preference for areas with shallower snow depths.

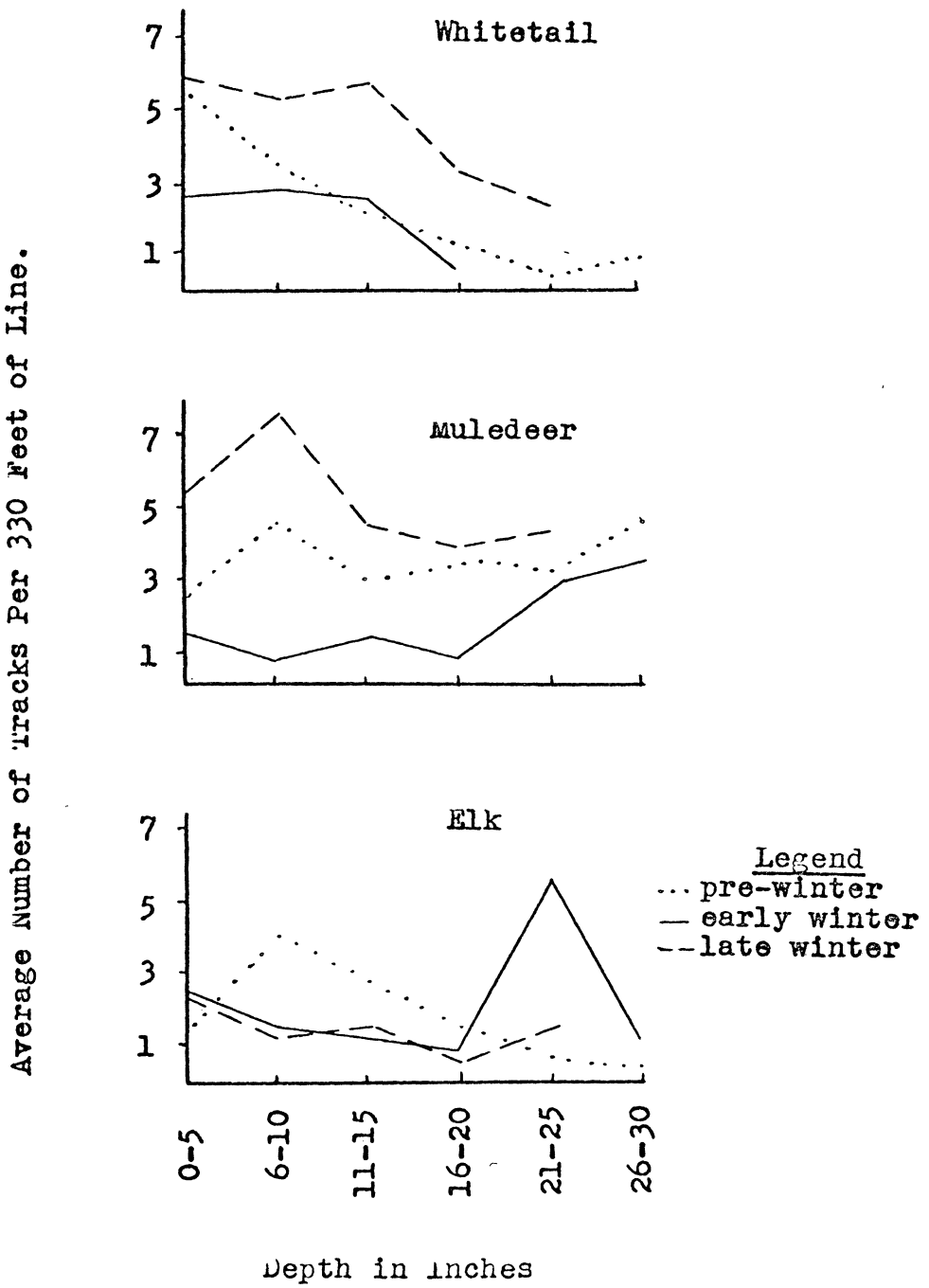


Figure 10. Tracks in relation to snow depth on intensive areas.

The mule deer ranged into deeper snow early in the season and as the season progressed there was a shift to shallower snow depths of ten to fifteen inches. Elk showed the same pattern as mule deer but their shift to shallower snow occurred later in the season than mule deer.

III. COVER FACTOR

The cover patterns exhibited on the various areas are the result of both natural and man made conditions. The only natural condition encountered was the grassland and the sharp ecotones between grass and timber. Logging and fire had modified the timber from its former condition. Most of the ponderosa pine sites now have a heavy admixture of Douglas fir and some have changed to a Douglas fir or Douglas fir-larch mixture. Lodgepole pine occurrence is due to heavy fires in the past (Weaver & Clements 1938). Very little spruce occurs at the elevation of the winter range, and then, it is found only in bottoms or moist areas. Juniper was rare and extremely scattered and was not considered as important.

Extensive Areas. Early and late winter observations are shown in Figure 11. White-tailed deer show a very strong preference for the ponderosa pine type either in mixtures or in pure stands. The use of Douglas fir was generally on logged-over ponderosa pine sites where it

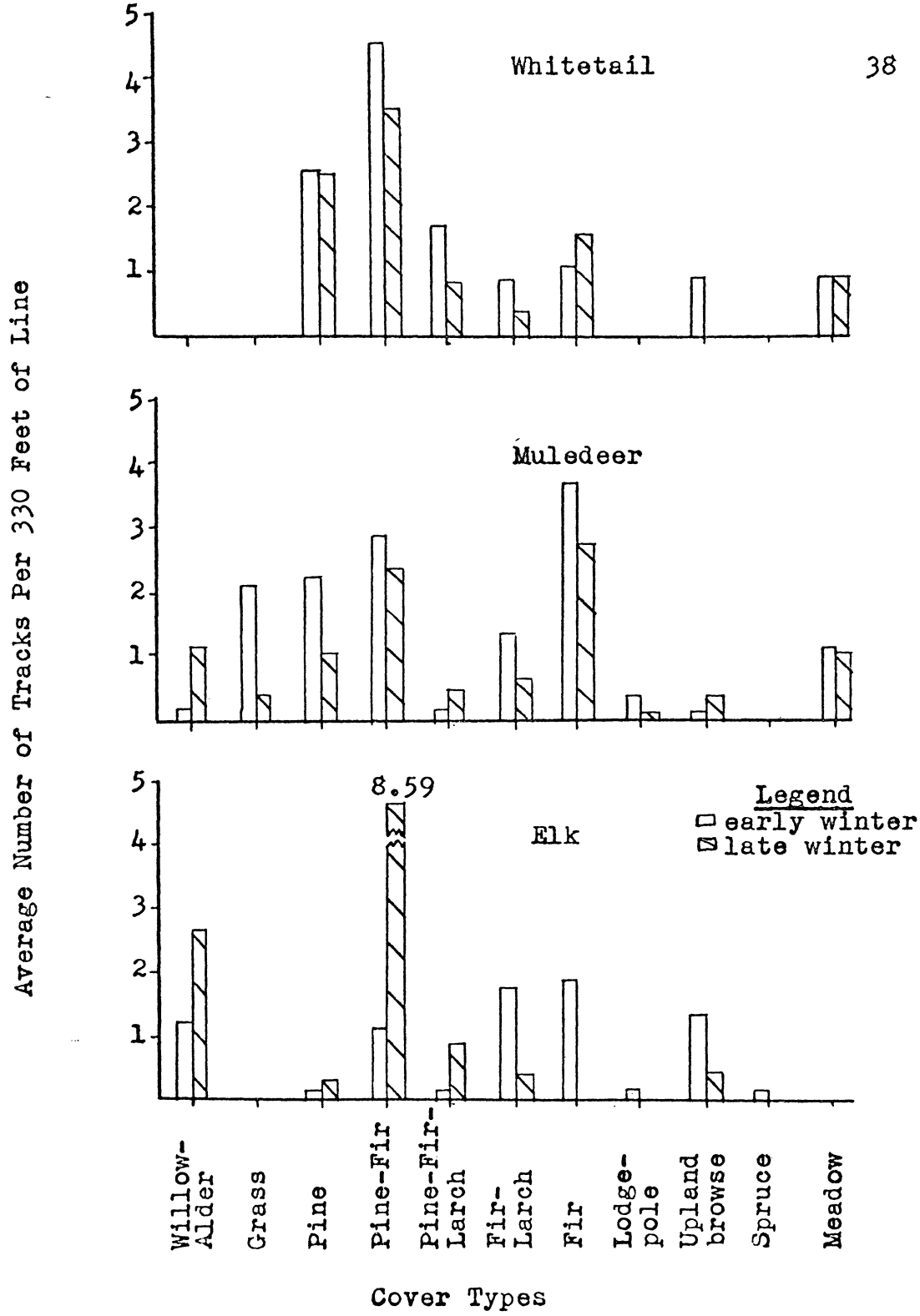


Figure 11. Tracks in relation to cover type on extensive areas.

would appear that ponderosa pine did not have a chance to regenerate due to competition from the Douglas fir. A ponderosa pine stand with small clumps of ponderosa pine or Douglas fir reproduction was the preferred cover type.

Mule deer were found in the Douglas fir or Douglas fir mixtures and the grass types or mixtures. In general, they showed a wide range of use. Common use of cover with the white-tailed deer resulted when the mule deer moved into the ponderosa pine-grass or ponderosa pine-Douglas fir types. This occured when a species of timber was missing and the animals shifted to another type.

Elk were erratic in their selection of cover. In early winter they showed little preference except for use of the brush types (bottom and upland types). During late winter they were found predominately in the ponderosa pine-Douglas fir type and to a lesser degree in the willow-alder type. Occurrence in the latter type appeared to be due to the forage available there.

Intensive Area. Figure 12 shows the distribution of animals with respect to cover. Pre-winter distribution of white-tailed deer indicates a high use of the mesic forests, usually associated with the more northernly exposures. The Douglas fir-larch areas used by the white-tailed deer during

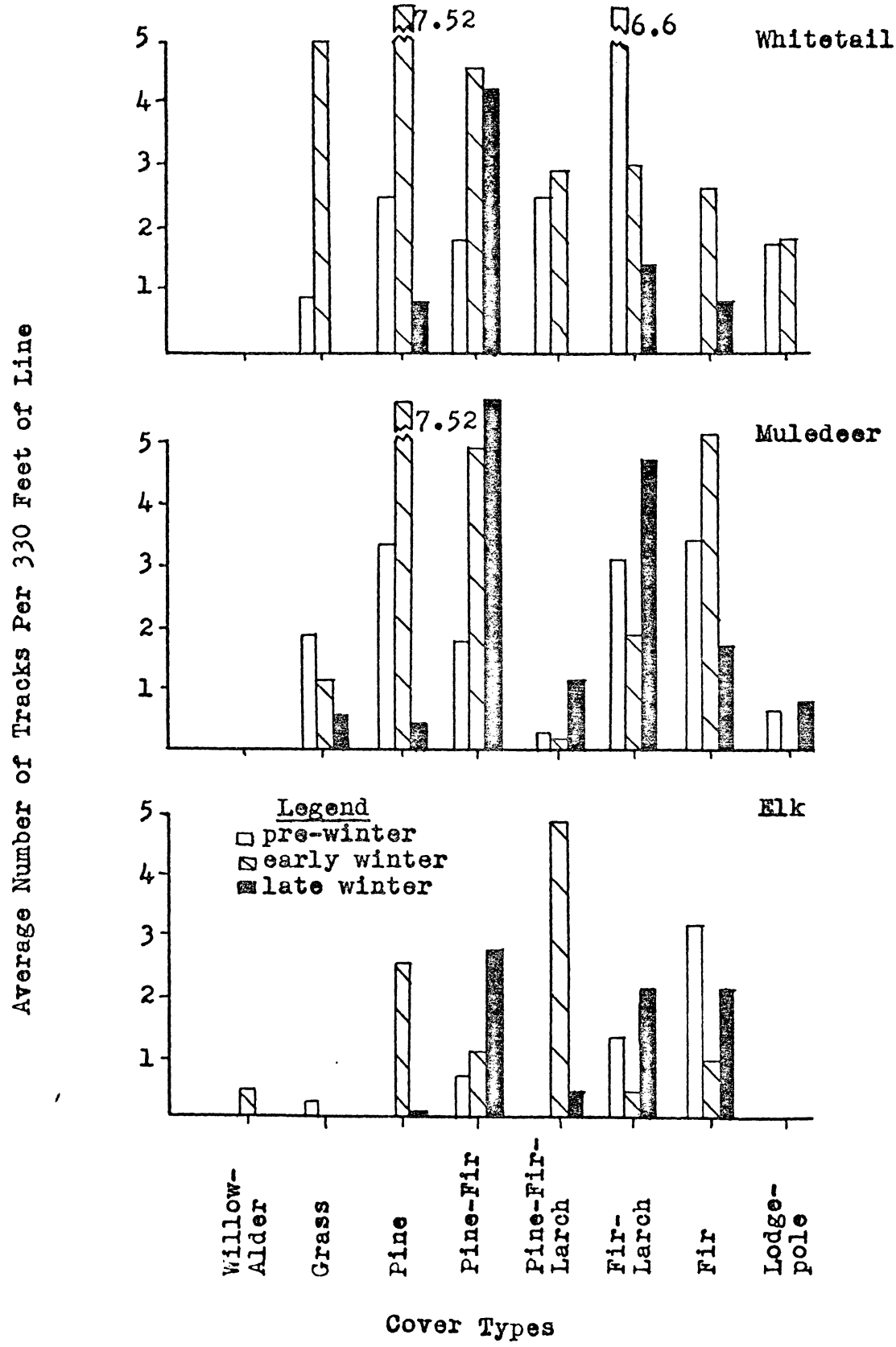


Figure 12. Tracks in relation to cover type on intensive areas.

this period made up one half of the natural type found on northernly exposures; whereas, the Douglas fir-larch types used later were on mixed pine-fir-larch sites that had been converted to a Douglas fir-larch type by logging.

Early winter brought a shift of white-tailed deer to the ponderosa pine types and a decline in the use of Douglas fir types. There was also a heavy use of grass types. White-tailed deer were observed feeding during January, on the open hills, with the mule deer. These open hills had only a small amount of snow and it could be seen that the animals were pawing for the small green blades of grass. This was determined by observations and checking. During this period white-tailed deer were still using the lodgepole pine type despite the deeper snow and scanty forage; however, a later check that same month indicated a movement out of the type. Late winter found the animals concentrated mainly in the ponderosa pine types.

Mule deer exhibited much the same pattern as the white-tailed deer, except for a higher preference of the Douglas fir types in early and late winter periods. During the early winter period mule deer and white-tailed deer were using many of the same cover types and considerable intermingling of the two deer was observed during this period.

The elk remained in the Douglas fir types most of the winter. During late winter a group of elk shifted to the northwest corner of the Blackfoot-Clearwater Game Range and into a ponderosa pine-Douglas fir type currently occupied by white-tailed deer. The cover types frequented by the elk contained a considerable accumulation of snow. The elk were traveling long distances in this snow to reach haystacks or to a feed line established by the State Game Department to lure them away from the ranches.

IV. EXPOSURE FACTOR

Exposure, as an environmental factor, has considerable influence on other factors of environment. Air temperature, wind, and availability of food are additional factors of exposure. The more southernly exposures are warmer and conditions are more favorable to animals. The use of these warmer exposures is governed by conditions on adjacent exposures and the rustling ability of the animals.

Extensive Areas. White-tailed deer concentrations occurred on the east to southwest slopes. The observation of white-tailed deer on more northernly exposures are due largely to trails crossing drainages, bedding down just over a ridge in heavier timber, or use of the northern slopes for escape. The use of level and rolling country resulted from

travel to and from water or use of lower flat ridges or benches. (See Figure 13).

Mule deer ranged on the south to west exposures but their greatest occurrence in early winter was in rolling country. As the snow became deeper in late winter they shifted from the rolling country to the more open south and west exposures.

Elk showed an erratic pattern using some of the warmer exposures such as south and southwest but also inhabiting the northern exposures and level country. This agrees with the information, previously given, on the ability of elk to "buck" heavier snow. Since the more northernly exposures have a greater accumulation of snow it is possible that elk may be more shy or require more protective cover during the day and this may be available only on northernly exposures.

Intensive Area. Pre-winter distribution of white-tailed deer indicates an expected higher use of the more northernly exposures. The early and late winter exposures are similiar to extensive areas except for a slightly greater use of the west exposure in late winter. (See Figure 14).

Mule deer showed little preference for exposure in

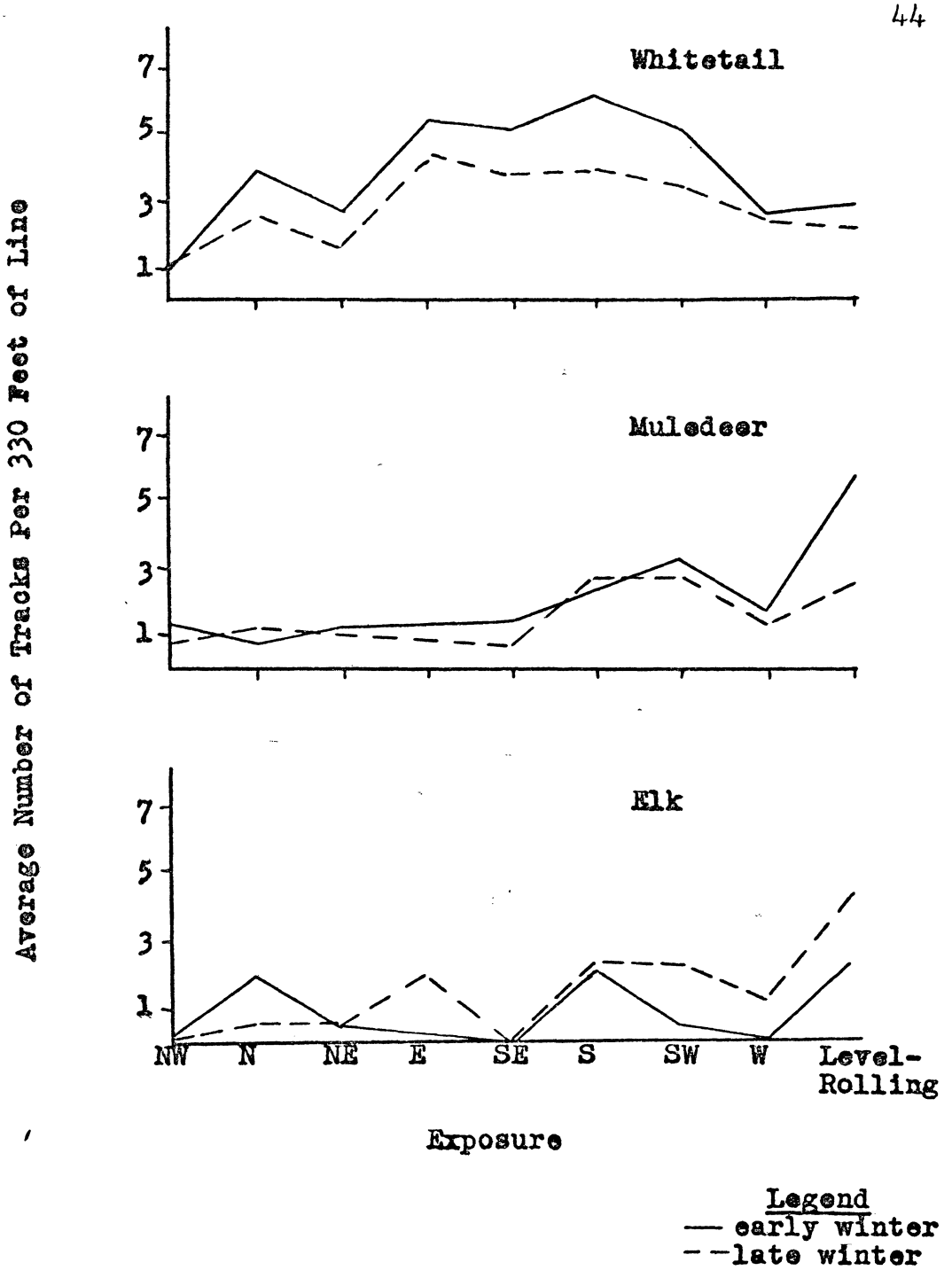


Figure 13. Tracks in relation to exposure on extensive areas.

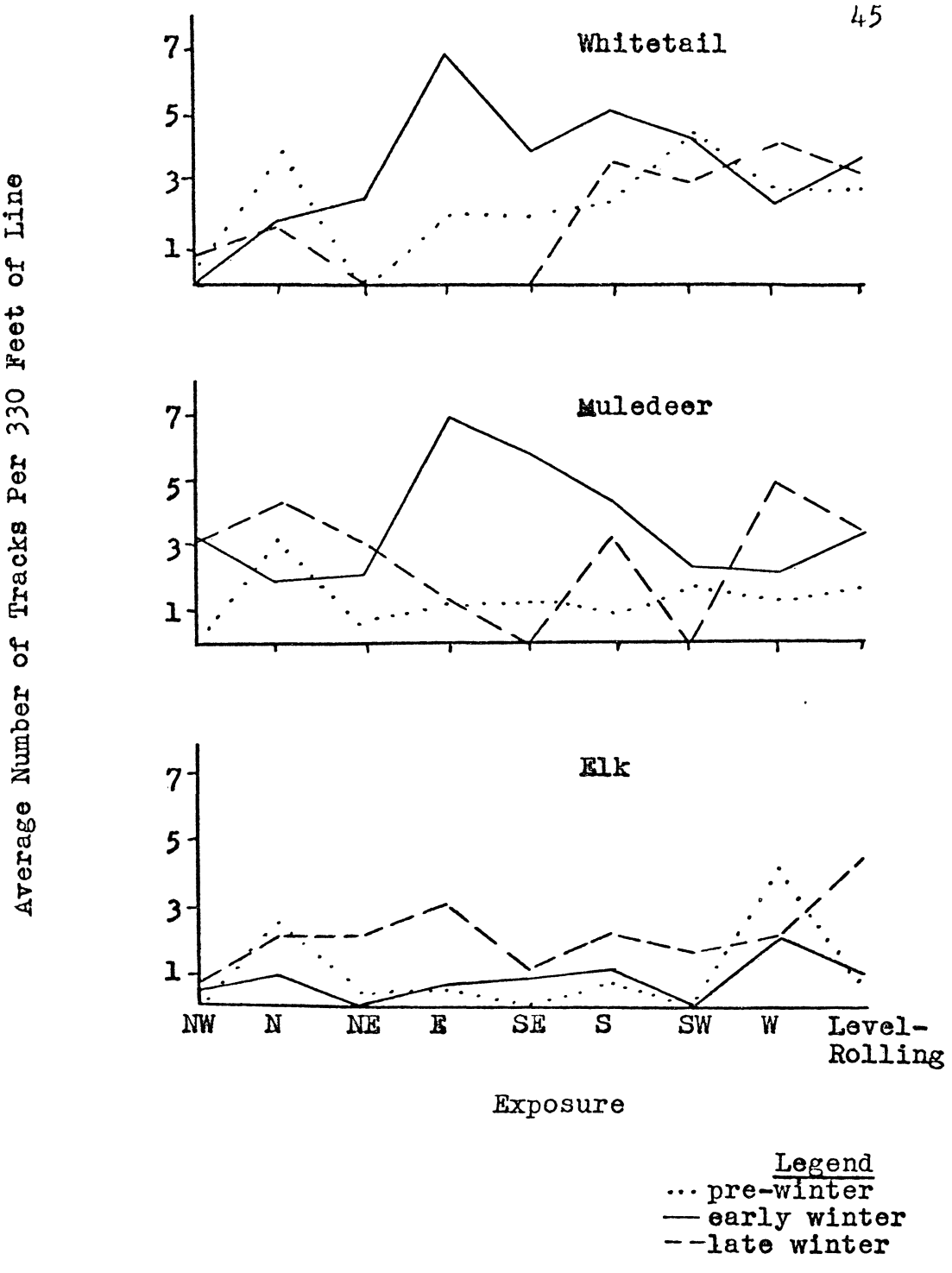


Figure 14. Tracks in relation to exposure on intensive areas.

their pre-winter distribution. During early winter they moved to the east and south exposures. The late winter pattern indicates a shift to western and northern exposures. Throughout the winter the rolling country received fairly constant use.

Elk preferred the west and northern exposures in the pre-winter study. The early and late winter studies showed a general use of all exposures with no preference indicated except for rolling country in late winter.

V. SLOPE FACTOR

Preference of animals for steep, gentle, flat, or broken country may be of some importance in habitat requirements. Probably the character of the slope is more important than the effect of slope on cover and snow depth since only the extremes of slope produce any marked change in cover and snow depth.

Extensive Areas. White-tailed deer occupied the five to fourteen per cent slope classes the most. They showed a steady decline in use of areas as the percentage of the slope increased. There was almost as much use of the slopes over thirty-five per cent as those below five per cent. (See Figure 15). This usage is reflected by the character of the slope. Had the slope been long and steep, instead of

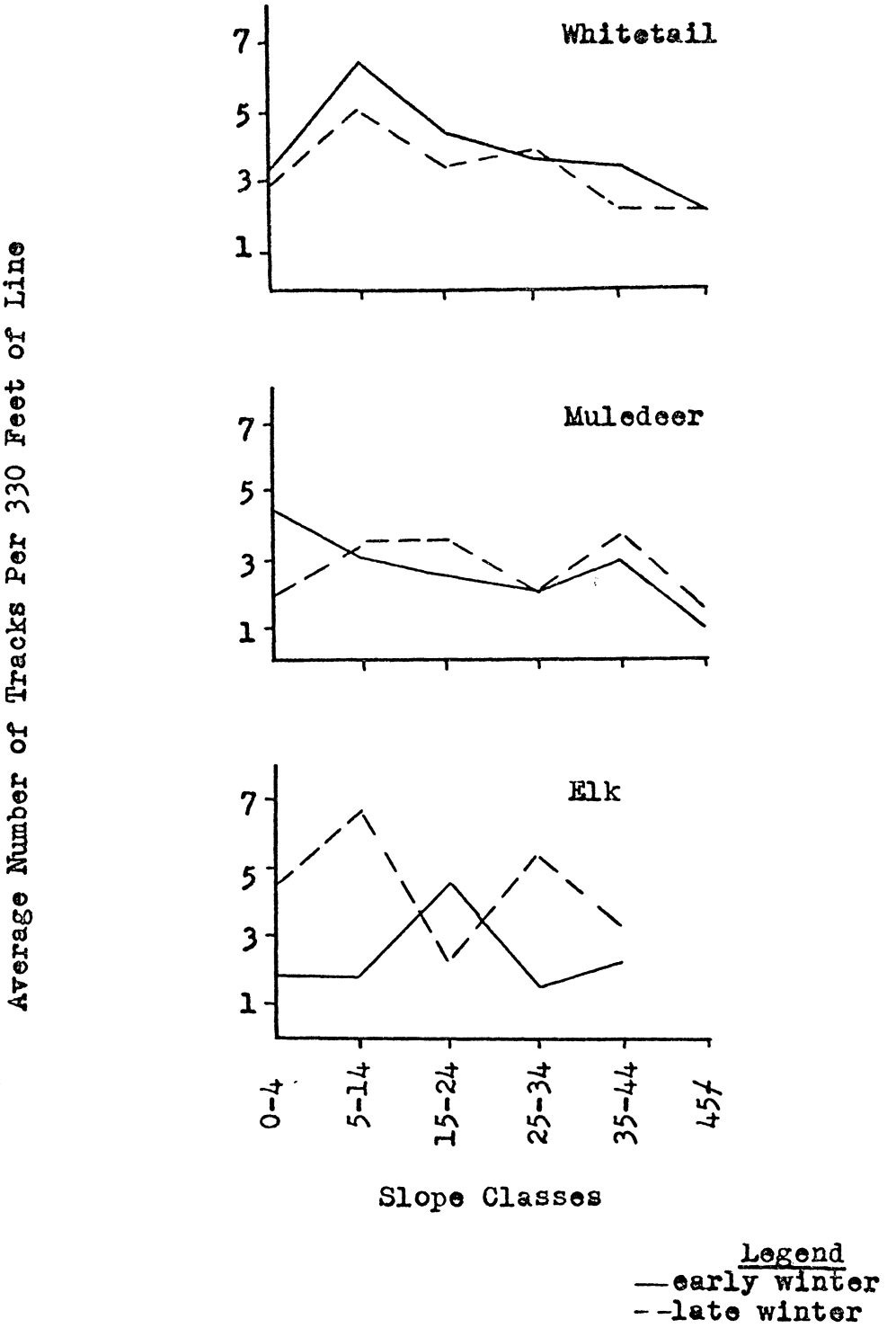


Figure 15. Tracks in relation to slope on extensive areas.

interrupted by shelves and benches, there would have been little use by white-tailed deer of those steeper slopes.

Mule deer used all slopes about equally, showing little preference for any particular slope. The long slopes were used quite extensively. The intermediate slopes, broken slopes, and rolling country were used moderately by the mule deer. The mule deer would use the steeper slopes, with rock outcrop and talus slides quite readily; whereas, white-tailed deer showed a definite absence from slopes of this character.

Elk were not too specific in their choice of slopes, but they make little use of the steeper slopes, i.e. slopes over thirty-five per cent. The pattern of use is irregular and does not lend itself to analysis.

Figures 16, 17, and 18 are profiles taken from a 200 foot contour map. These profiles are indicative of the data presented in the last three paragraphs.

Intensive Area. White-tailed deer show a marked usage of all slope classes. (See Figure 19). The key to the pattern is, again, the character of the slope. The broken slopes were used quite extensively.

Mule deer used the steeper slopes ranging from

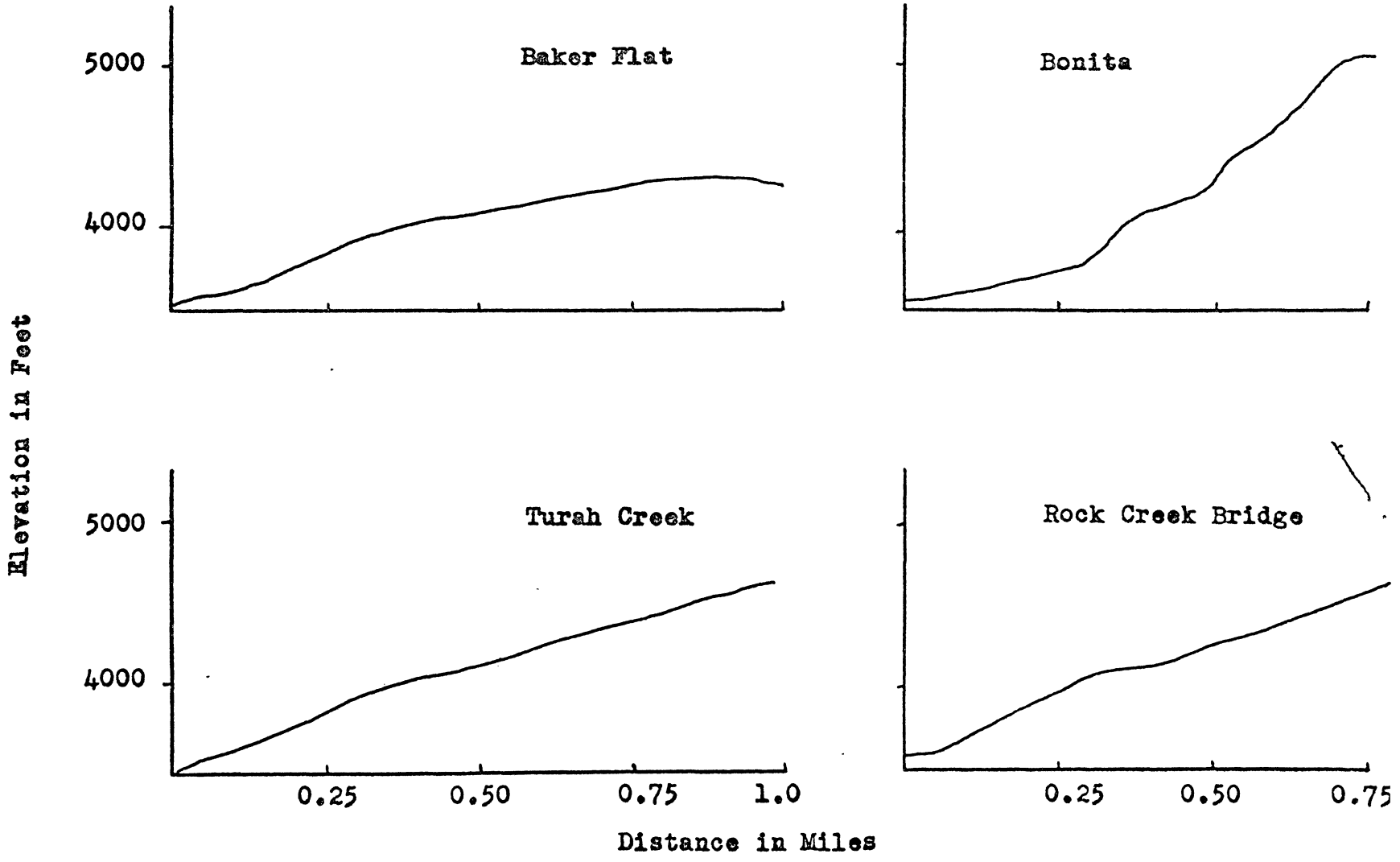


Figure 16a. Slope profiles of white-tailed deer winter ranges in extensive areas.

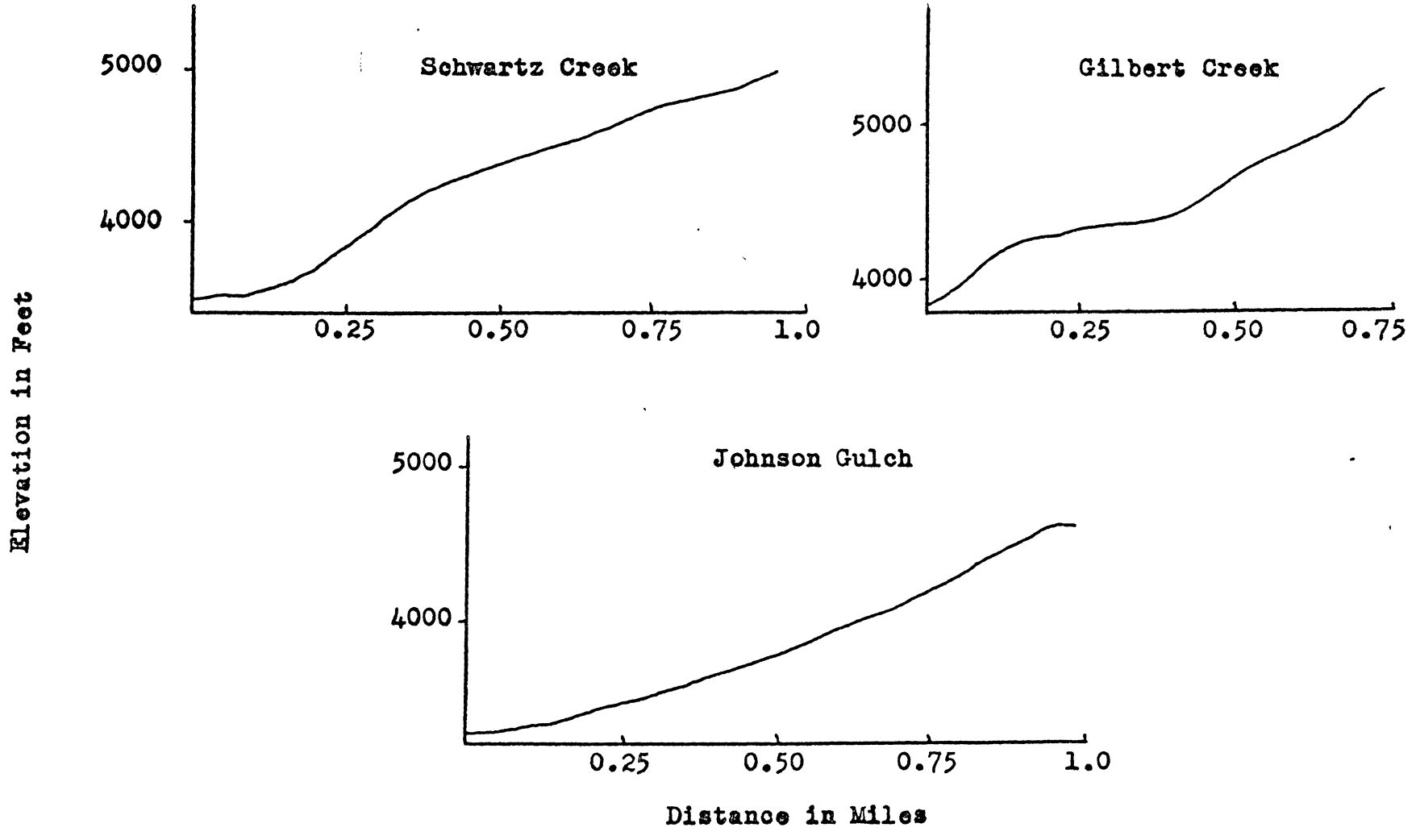


Figure 16b. Slope profiles of white-tailed deer winter ranges in extensive areas.

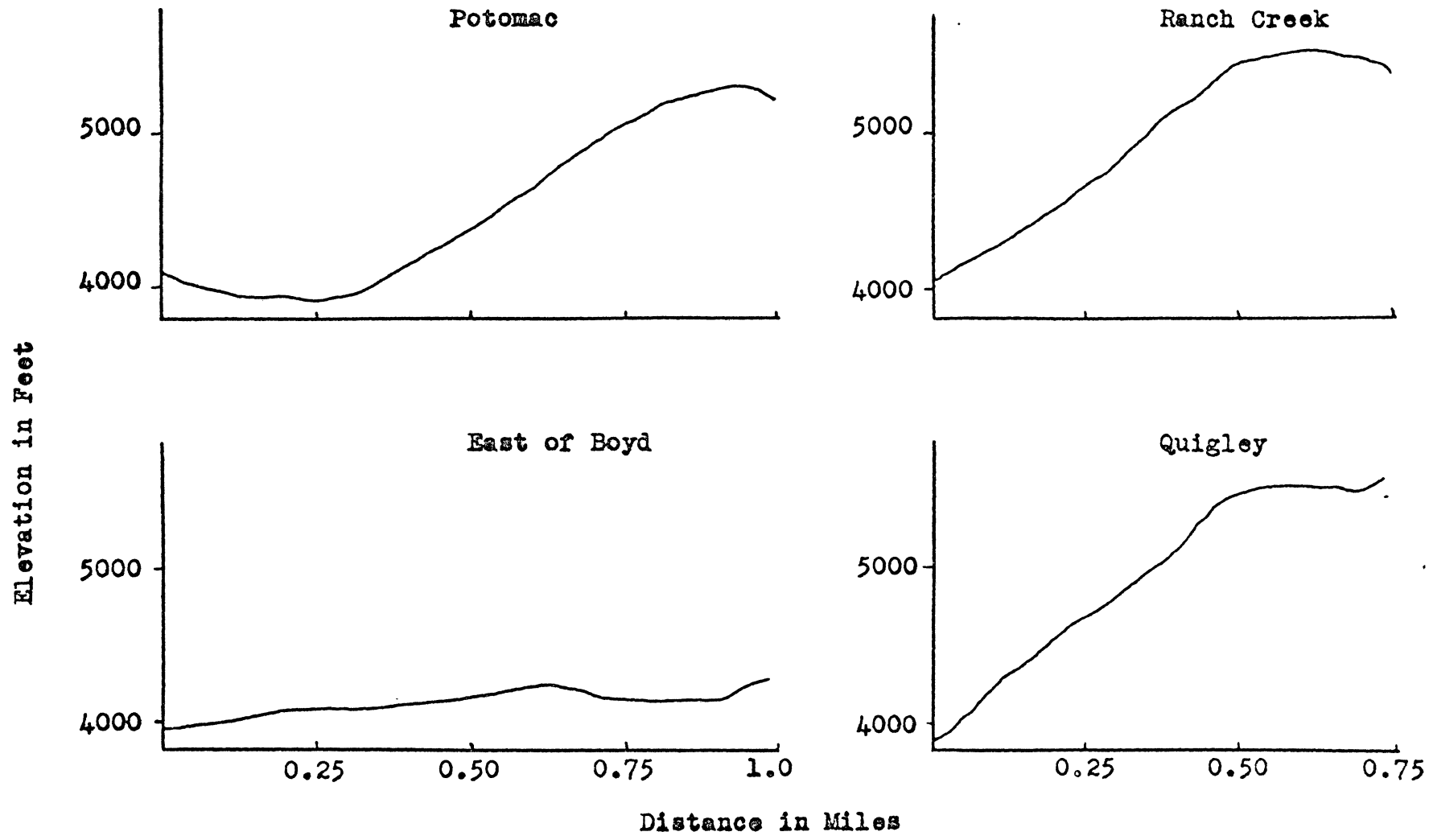


Figure 17. Slope profiles of muledeer winter ranges on extensive areas.

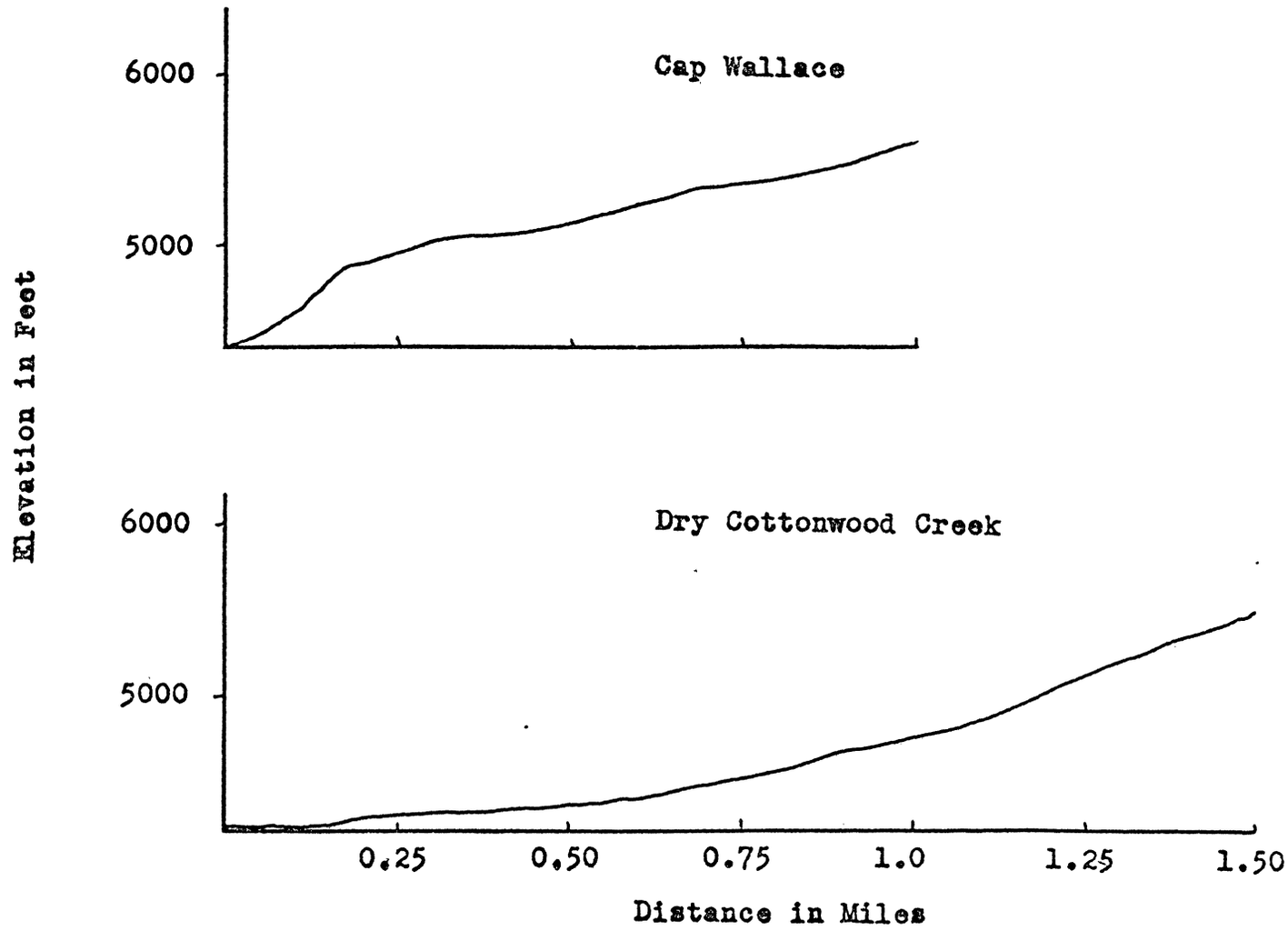


Figure 18. Slope profiles of elk winter ranges on extensive areas.

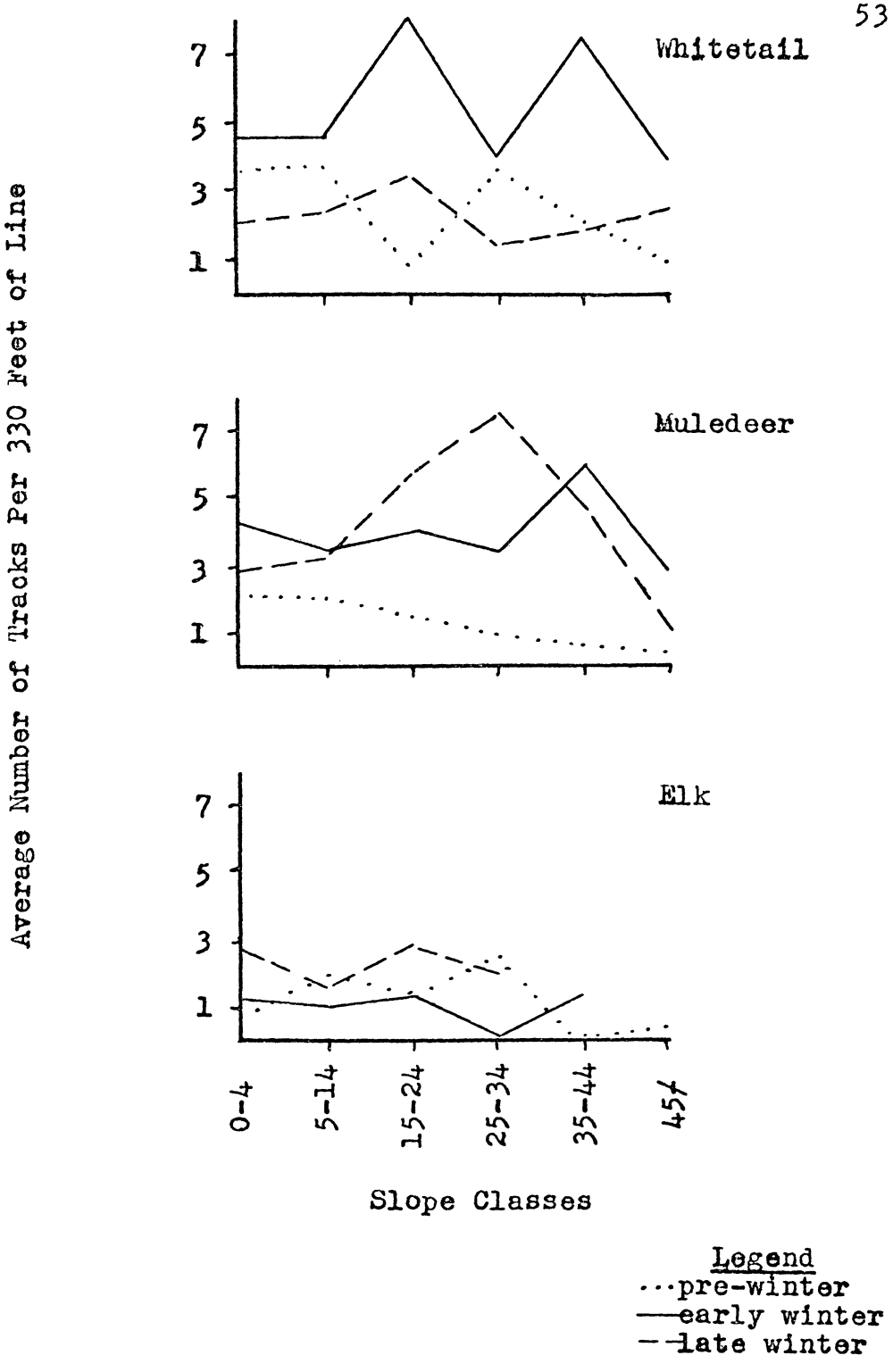


Figure 19. Tracks in relation to slope on intensive areas.

twenty to forty per cent. The character of the slope has been discussed previously under extensive areas.

Elk were not too specific in their choice of slopes, except that the slopes generally used were under forty per cent.

VI. BROWSE COMPOSITION

The understory of the various types provides forage and some cover for the animals. The understory varies with the type of overstory and the site, but it was not recorded by type or site. Some plants, such as willow and snowberry, occur on many different sites. Serviceberry and ceanothus are common to the drier upland. Chokecherry is found in draws as well as upland areas. Mountain maple, dogwood and aspen are characteristic of bottoms and mountain maple will extend up on northernly slopes where there is more moisture. Only brush and grass were measured because they are the dominant portion of the understory during winter. (See Figure 20 for a list of common and scientific names). Common names will be used in all discussions of plants.

Extensive and Intensive Areas. White-tailed deer range had the characteristic shrubs of ponderosa pine sites. Serviceberry, chokecherry, ninebark, snowberry, rose, and upland willow were the predominate shrubs. The lowland types

Common Name	Scientific Name
Alder	Alnus tenuifolia
Aspen	Populus tremuloides
Blackbirch	Betula fontinalis
Ceanothus	Ceanothus velutinus
Chokecherry	Prunus virginiana demissa
Cottonwood	Populus trichocarpa
Dogwood	Cornus stolonifera
Hollygrape	Berberis repens
Huckleberry	Vaccinium occidentale
Twinberry	Lonicera involucrata
Juniper, Rocky mtn.	Juniperus scopulorum
Mock Orange	Philadelphus lewisia
Mtn. Maple	Acer glabrum douglasi
Nannyberry	Shepherdia canadensis
Ninebark	Physocarpus malvaceus
Oceanspray	Holodiscus discolor dumosus
Rabbitbush	Chrysothamnus nauseosus
Ribes	Ribes spp.
Rose	Rosa spp.
Sage, big	Artemisa tridentata
Sage, fringe	A. frigida
Serviceberry	Amelanchier alnifolia
Spirea	Spirea lucida
Snowberry	Symphoricarpos albus
Thimbleberry	Rubus parviflorus
Thornapple	Crataegus douglasi
Willow	Salix spp.

Figure 20. List of plants observed during this study. Names were taken from Kelsey's and Dayton's (1942) book of "Standardized Plant Names".

frequented by white-tailed deer during other seasons of the year were present only as a small percentage and some of the lowland species such as cottonwood and alder are not represented. The presence of nannyberry and ocean spray indicates the use of cover with a high crown and cover density such as found in lodgepole pine and Douglas fir respectively (See Tables 3 and 4 for composition of winter range).

Mule deer range had less serviceberry and more grass than white-tailed deer and elk areas. In several areas where sagebrush occurred mule deer made use of this type and neither white-tailed deer nor elk were found there. The open rolling country, frequented by mule deer, was characterized by the presence of more grass and sagebrush than the timber areas.

The composition of elk range differed from deer range in a number of ways. No ninebark was encountered in isolated areas of elk use, but it was present on areas of joint use with deer. The low growing plants such as bearberry, hollygrape, huckleberry, and grass were very limited in amount. The areas of deeper snow frequented by elk covered these species. More of the bottom land types were present such as cottonwood, hawthorn, lowland willow, dogwood and mountain maple. Plants of the denser timber such as

Table 3. Percent composition of brush and grass on extensive areas.

	Whitetail		Muledeer		Elk	
Species	Early	Late	Early	Late	Early	Late
Alder	-	-	7.14	4.5	8.25	-
Aspen	4.7	7.28	1.94	5.26	.7	.95
Bearberry	-	.06	.03	.7	-	-
Ceanothus	.41	1.37	.46	1.39	.75	.25
Chokecherry	4.8	4.73	1.4	2.5	2.2	1.0
Cottonwood	-	-	.01	.01	.05	.25
Dogwood	-	-	.92	-	2.35	.25
Grass	1.75	2.71	13.01	16.5	2.2	.25
Hollygrape	.07	-	-	-	.05	-
Huckleberry	-	.08	.05	.08	-	-
Juniper	1.25	1.91	.9	.2	-	-
Mock Orange	1.34	7.1	1.85	5.6	.33	-
Mountain Maple	1.21	2.76	3.8	1.7	7.15	5.0
Nanny berry	.11	.14	.1	.6	.9	.2
Ninebark	25.1	17.4	22.32	20.7	-	-
Oceanspray	.11	.82	-	-	-	-
Rabbitbrush	-	-	.01	-	-	-
Ribes	-	.21	.04	.5	-	-
Rose	1.93	1.32	1.84	1.0	1.0	2.6
Sage (big)	-	-	.01	.05	-	-
Sage (fringe)	-	-	.57	.07	-	-
Serviceberry	34.4	32.0	16.91	13.8	37.85	44.75
Snowberry	17.3	8.71	17.91	16.8	19.55	31.6
Spirea	.64	1.3	.95	.5	1.0	1.5
Thimbleberry	.11	-	-	-	-	-
Thornapple	.03	.06	.04	.06	10.85	1.1
Willow	4.64	10.04	7.79	7.4	5.25	.3
	100.00	100.00	100.00	100.00	100.00	100.00

Table 4. Percent composition of brush and grass on intensive areas.

Species	Whitetail			Muledeer			Elk		
	Dec.	Jan.	March	Dec.	Jan.	March	Dec.	Jan.	March
Alder	-	-	-	3.2	5.5	-	-	5.3	2.7
Aspen	-	-	-	.6	2.8	-	.8	8.3	.2
Boarberry	-	-	3.1	-	-	-	-	-	-
Black birch	-	-	-	5.7	-	-	.4	-	-
Ceanothus	-	-	15.6	-	-	3.7	8.4	-	-
Chokecherry	-	-	63.0	.2	-	1.3	3.8	.92	.5
Cottonwood	-	-	-	-	-	-	-	-	.7
Dogwood	-	-	-	4.4	3.4	-	-	5.2	1.0
Grass	1.8	-	-	.1	.7	1.8	-	-	-
Hollygrape	-	-	7.0	.1	-	-	-	-	-
Huckleberry	-	-	-	.5	1.3	-	-	-	.2
Mock Orange	-	-	-	2.1	-	-	-	-	-
Mountain Ash	-	-	-	.3	-	-	-	-	-
Mountain Maple	4.7	-	-	3.5	11.4	5.7	10.1	4.5	18.5
Nannyberry	5.4	-	1.6	3.2	-	-	-	.5	1.4
Ninebark	1.0	-	.8	4.8	6.7	-	-	-	-
Oceanspray	.5	-	-	-	-	-	-	-	-
Rose	8.0	3.8	-	5.0	2.9	.4	1.9	.11	1.4
Sage (big)	-	-	-	-	.2	-	-	-	-
Serviceberry	35.9	69.1	46.1	34.3	18.8	87.1	47.3	56.1	54.7
Snowberry	27.9	26.1	18.7	24.7	38.2	-	21.3	19.1	11.2
Spirea	8.0	-	-	1.6	.9	-	-	-	2.5
Thornapple	-	-	.8	-	-	-	2.6	.23	-
Twinberry	-	-	-	-	-	-	-	-	.7
Willow	6.8	1.0	-	5.7	6.8	-	3.4	.19	4.3

nannyberry were also present.

VII. BROWSE FOOD HABIT

This study was not concerned with the rate of stocking and range condition; therefore, the food habit is not related to quantity of range but rather to the time of observation and composition of the understory on fairly representative ranges in western Montana. The food habit is based on the following key species of browse: serviceberry, chokecherry, willow, mountain maple, ceanothus, and dogwood. It was found that these six species of browse comprised the main portion of the deer and elk diet, although grass, particularly green grass, was taken heavily during several periods of open weather. On any range, animals will establish a natural selection for different plants. The degree of similarity or dissimilarity should indicate the possible competition.

Extensive Areas. Serviceberry was the most important single item of diet for all animals. It comprised from thirty-nine to seventy-six per cent of the diet of all animals studied. During early winter, serviceberry constituted fifty per cent or more of the diet. The deer use of this important shrub decreased in late winter but elk use increased. (See Table 5).

Table 5. Relation of browse food habit to browse composition on extensive areas.

Species	1/ Food Habit Early Winter	2/ Percent Composition	Food Habit Late Winter	Percent Composition
Whitetail				
Ceanothus	2.1	.41	9.47	1.37
Chokecherry	15.8	4.8	16.8	4.73
Mountain Maple	3.0	1.21	5.07	2.76
Serviceberry	76.0	34.4	60.8	32.0
Willow	3.1	4.64	7.86	10.04
	100.0		100.00	
Muledeer				
Ceanothus	12.2	.46	17.03	1.39
Chokecherry	10.8	1.4	28.1	2.5
Dogwood	-	.92	-	-
Mountain Maple	9.1	3.8	7.33	1.7
Serviceberry	51.1	16.9	39.62	13.8
Willow	16.8	7.8	7.92	7.4
	100.0		100.00	
Elk				
Ceanothus	4.8	.75	.8	.25
Chokecherry	7.4	2.2	1.9	1.0
Dogwood	3.7	2.35	.5	.25
Mountain Maple	18.8	7.15	7.95	5.0
Serviceberry	50.6	37.9	65.05	44.8
	100.0		100.00	

1/ Ounces of use of each species converted to percent.
2/ Taken from Table 3.

White-tailed deer showed the following early winter food habit: serviceberry 76%, chokecherry 15.8%, willow 3.1%, mountain maple 3%, and ceanothus 2.1%. The ratio of serviceberry to chokecherry was approximately five to one. During late winter serviceberry composed 60.8% of the browse diet, chokecherry 16.8%, ceanothus 9.5%, willow 7.8%, and mountain maple 5.1%. The ratio of serviceberry to chokecherry decreased to slightly less than four to one. All species showed a proportional increase in use, except serviceberry. This change in food habit accompanied the change in composition. The composition of serviceberry decreased, chokecherry remained the same and the others showed an increase in composition. There was no direct correlation of change in composition to the change in food habit since the percentage of increased or decreased use was not commensurate with the increase or decrease in composition.

Mule deer indicated the following browse food habit during early winter: serviceberry 51.1%, willow 16.8%, ceanothus 12.2%, chokecherry 10.8%, and mountain maple 9.1%. The serviceberry-willow ratio was slightly more than three to one and the ratio of serviceberry to the other three (taken individually) was approximately five to one. The late winter food habit was similar to white-tailed deer in species used but the amount taken varied considerably.

Serviceberry composed 39.6% of the diet, chokecherry 28.1%, ceanothus 17%, willow 7.9%, and mountain maple 7.33%. The serviceberry-chokecherry ratio, for example, was three to two.

Elk had only one similarity in food habit with the deer, namely the dominance of serviceberry in the elk diet. Mountain maple and willow were used more heavily by elk than deer and dogwood was taken by elk and not by deer, this was due to the absence of dogwood from deer areas. Chokecherry and ceanothus were not heavily used. The early winter and late winter preference was almost the same except for the change in amounts taken. During early winter elk used serviceberry 50.6%, mountain maple 18.8%, willow 14.7%, chokecherry 7.4%, ceanothus 4.8%, and dogwood 3.7%. The serviceberry-mountain maple ratio was approximately five to two and the serviceberry-willow ratio was slightly over five to one. During late winter, mountain maple 7.75% and willow 23.8% exchanged positions. Serviceberry was taken 65% and the rest were below 2%. The serviceberry-mountain maple ratio, during late winter, was eight to one and the serviceberry-willow ratio was three to one.

Intensive Area. The white-tailed deer pre-winter food habit was serviceberry 87.4%, willow 8.92%, and mountain maple 3.68%. During this period the deer were taking bear-

berry, hollygrape, and some green grass. Bearberry and hollygrape were not measured due to the small percentage of the composition and difficulty of determining annual growth. Early winter use of serviceberry was very high but it was during this period that deer were observed using the small green blades of grass on the open hills. In late winter the use of chokecherry 43.5% surpassed that of serviceberry 24.2% with a ratio of almost two to one. The ceanothus 32.2%-serviceberry ratio was four to three. (See Table 6).

Mule deer were taking about ninety one per cent serviceberry during the pre-winter season. This was supplemented by use of mountain maple 8.6%, bearberry, hollygrape and grass. Early winter food preference was willow 44.16%, mountain maple 32.1%, serviceberry 21%, and dogwood 2.49%. The willow-serviceberry ratio was over two to one and the mountain maple-serviceberry ratio was three to two. This is the only observation of deer taking dogwood, but does indicate that deer would use dogwood if it was present in great amounts. Small blades of green grass were eagerly sought by mule deer during this period. Serviceberry was almost 98.5% of the browse diet during late winter, with chokecherry 1.5%. Grasses were taken wherever the deer could find them.

Table 6. Relation of browse food habit to browse composition on intensive areas.

Species	1/ Food Habit Pre-Wint.	2/ Percent Comp.	Food Habit Early Wint.	Percent Comp.	Food Habit Late Wint.	Percent Comp.
Whitetail						
Ceanothus	-	-	-	-	32.2	15.6
Chokecherry	-	-	-	-	43.5	6.3
Mountain Maple	3.68	4.7	-	-	-	-
Serviceberry	87.4	35.9	100.0	69.1	24.2	46.1
Willow	8.92	6.8	-	1.0	-	-
	100.0		100.0		100.0	
Muledeer						
Chokecherry	-	.2	-	-	1.45	1.3
Dogwood	-	4.4	2.49	3.4	-	-
Mountain Maple	8.6	3.5	32.1	11.4	-	5.7
Serviceberry	91.4	34.3	21.25	18.8	98.55	87.1
Willow	-	5.7	44.16	6.8	-	-
	100.0		100.00		100.00	
Elk						
Ceanothus	-	8.4	-	-	-	-
Chokecherry	.96	3.8	1.09	.92	-	.5
Dogwood	-	-	9.54	5.2	-	1.0
Mountain Maple	96.1	10.1	13.82	4.5	47.8	18.5
Serviceberry	2.94	47.3	69.66	56.1	48.3	54.7
Willow	-	3.4	5.89	.19	3.9	4.3
	100.00		100.00		100.0	

1/ Ounces of use of each species converted to percent.
2/ Taken from Table 4.

Elk used mountain maple 96.1% almost exclusively during the pre-winter season with serviceberry 2.94% and chokecherry 0.96% of their diet. This was supplemented by use of cured grass. During this period the elk began their nightly raids on ranchers' haystacks in the vicinity of the Blackfoot-Clearwater Game Range. These raids continued as long as they could find an unfenced haystack. If ranchers were asked what the food habit of elk was they would say one hundred per cent hay. There is little doubt that some elk took hay as a good portion of their diet, considering the amount of hay used. The State Game men established a feed line to lure the elk away from the ranchers' hay stacks. The feed that was strung out for several miles was hay with some high protein pellets. It was intended that pellets would provide most of the proteins required and the elk were supposed to "stuff" on browse of lower preference, than normal, to provide a "filler". The food habit of elk and in this study a careful check of browse plants failed to show this result. During early and late winter elk showed much the same food habit as in the extensive areas. In early winter serviceberry 69.66% was highly preferred followed by mountain maple 13.92%, dogwood 9.54%, willow 5.89%, and chokecherry 1.09%. Mountain maple 47.8% was taken almost as much as serviceberry 48.3% during late winter and willow amounted to 3.9% of the food habit.

The change in composition and availability, due to snow conditions, was followed by a change in food habit but there was no direct correlation between the two changes.

VIII. DISTANCE FROM WATER

All animals can obtain water from snow but some animals require open water and do not use snow but sparingly. Distance from open water may be a factor affecting the distribution of animals. Table 7 shows the average distance from water. The distance was determined by observing the center of concentration and measuring the distance on a map to the nearest open water.

A striking character of white-tailed deer range is the presence of well defined trails leading to water. Mule deer did not follow well defined trails to water and in most cases there were only a few tracks going to water. The low number of tracks going to water was out of proportion to the tracks and number of mule deer observed on the area. Elk showed heavy use of willow-alder bottoms where they existed. They were probably lured by the forage rather than the water. Where willow-alder bottoms were absent the pattern of use was similar to mule deer. This indicates a versatile relation of elk to method of obtaining moisture.

Table 7. Distance of Concentration Areas from Water

		Distance in miles
White-tailed deer		
Gilbert Creek		.5
Turah		.13
East of Gilbert		.25
Beavertail Hill		.5
Baker Flat		.5
Gold Creek		.25
East Twin Creek		.25
Johnson Gulch		.25
Bonita		.5
Schwartz Creek		.25
Rock Creek Bridge		.25
	Total	3.63
	Average	.33
Mule deer		
East of Gilbert		1.0
Beavertail Hill		.5
Quigley		.5
Ranch Creek		1.25
Brown Ranch		.5
Potomac		.5
Harvey Creek		.25
West Twin Creek		.25
East of Boyd Ranch		.13
Cap Wallace		.13
	Total	5.01
	Average	.50
Elk		
Baker Flat		.13
Gold Creek		.25
East Twin Creek		.25
Harvey Creek		.13
West Twin Creek		.25
East of Boyd Ranch		.13
Cap Wallace		.25
Dry Cottonwood Creek		.5
	Total	1.89
	Average	.24

IX. MISCELLANEOUS OBSERVATIONS

Social Nature. It was observed that white-tailed deer usually occurred singly or in small groups up to five. Mule deer were more gregarious, they were usually encountered in groups of five to fourteen. Large herds of elk were seen from the ground, sometimes as many as seventy in a herd. State Game men flying the area reported elk herds numbering over one hundred animals. On a number of occasions white-tailed deer were observed bedding down or foraging with mule deer and one observation was made of a calf elk mingling with a herd of mule deer. No fraternization of white-tailed deer and elk was observed.

DISCUSSION

The animal patterns expected did not materialize in all cases. The below normal snow accumulation allowed the elk to winter at higher elevations than normal. In all cases of pattern failure except one the elk did not winter on their normal range. The other failure was at Harvey creek, where a small herd of white-tailed deer was reported wintering at the mouth of the creek. The only animals wintering in this area were one elk and a herd of mule deer numbering about forty-five. Checks with local ranchers working in this area confirmed my observations, since they reported no white-tailed deer seen. The cottonwood bottom had only an occasional track crossing through and the animals wintered well up on the slope. It is my opinion that had white-tailed deer been present, heavier use would have been made of the cottonwood bottom. In several other cases animals moved into an area for a short period then moved out. On Baker Flat elk were present in a white-tailed deer area for a week in January and on Cap Wallace a small herd of mule deer moved into elk range the latter half of March.

It is apparent, from the factors analyzed, that snow depth appears to be the principal factor operating to limit the winter ranges of white-tailed deer, mule deer, and elk

in the areas studied. White-tailed deer appear to utilize areas of little snow but traveled through deeper snow to reach water. Mule deer and elk were less restricted by deeper snow. Snow depth affects the composition and availability of the understory and consequently the food habit of the animals. Accumulation of snow is influenced by the exposure and cover. The warmer southernly exposures and those exposures swept by winds reduce the accumulation of snow. Cover types with moderate density accumulate and hold snow for long periods. The open cover types did not accumulate much snow.

Cover indirectly affected distribution by its influence on snow depth and food. White-tailed deer favored the ponderosa pine types, particularly those with small clumps of reproduction. Mule deer were less selective and made heavier use of Douglas fir and grass types than white-tailed deer. Elk preferred heavy cover as afforded by Douglas fir mixtures but they shifted to more open types in late winter. Escape cover was important on white-tailed deer areas. The nearness of heavy cover either in the form of clumps of reproduction or a more efficient escape route on northern slopes with its heavier cover was important. Elk made a habit of retiring to heavy cover during the day and foraging out in more open country between the evening

and early morning period. Mule deer ranged on fairly open country as well as heavy cover but apparently did not rely on escape cover as part of their environment.

The most important indirect factor influencing distribution is exposure. It regulates the depth of snow, type of cover and understory of browse along with air temperature, wind and availability of food. White-tailed deer favored the southernly exposures. Mule deer were less selective and used rolling country and northern exposures more than white-tailed deer. White-tailed deer use of northern exposures was either for escape cover or moving to another area; whereas, mule deer would forage on the northern slopes. Elk were not selective in their exposure preference, except for slightly higher use of rolling country in late winter.

Slope has little effect on other factors of environment as only extremes of slope produce any effect on cover types and snow depth. The principal influence of slope on animal distribution is the character of the slope. The short slopes and broken slopes are preferred by white-tailed deer. They used mainly the lower slope classes and the steep slopes if short and intermixed with benches. Mule deer frequent the long, moderate to steep slopes. Slope had little effect on elk except that slopes over forty per cent were only slightly used.

Composition of the understory is affected by snow depth, cover, and exposure. The light and moisture requirements of the plants determine their prescence on a given site and in relation to certain cover types. The differences in composition between the ranges of these various animals is reflected by the type of cover and exposure used by them. White-tailed deer range was characterized by serviceberry, chokecherry, ninebark, snowberry and upland willow. These plants are part of the ponderosa pine complex frequented by white-tailed deer. Mule deer occurred in areas with a higher percentage of grass and sagebrush. This is due to the open country used by mule deer in certain areas. Elk range had fewer low plants such as bearberry, Oregon grape, etc. due to the deeper snow. Likewise there was more mountain maple, dogwood, hawthorn, etc. because of heavier use of bottoms.

The composition of the various game ranges included many different shrubs but of these shrubs six species comprised over ninety per cent of the diet. Serviceberry was the most important single item of diet, and in most cases it provided over fifty per cent of the diet.

It was possible to determine whether deer or elk browsed a plant. The elk would reach higher, nip cleaner, and there was usually some breakage of larger stems. (See

Photographs 1 and 2 in Appendix). Deer did not have the reach of elk and very little breakage occurred. Their nipping generally left a ragged edge with a mashed, frayed appearance. These observations were not used in determining the species of animals using an area, but rather they are the results of work in areas of known animal use. Animals actually seen and tracks were used to confirm the species of animal present.

On extensive areas white-tailed deer and mule deer showed similar food habits except that mule deer took less serviceberry and proportionally more of the other plants. On intensive areas there was considerable difference in their food habits. White-tailed deer took serviceberry, chokecherry and ceanothus heavily; whereas mule deer took serviceberry, mountain maple and willow heavily. On extensive areas elk took serviceberry, mountain maple, and willow, and on the intensive area the serviceberry and mountain maple were preferred. Elk were using dogwood in smaller amounts but little use was made of dogwood by the deer due to its absence from the deer winter range.

Serious competition for serviceberry could occur on areas of joint use. Competition for other species would involve mule deer and elk, since there is very little similarity of food habit between white-tailed deer and elk

except for serviceberry. The mule deer appear to be the most versatile in these areas when it comes to food habit.

White-tailed deer prefer open water to snow for meeting their water requirements. The well beaten trails leading to water are characteristic of their range. Mule deer and elk apparently can obtain most of their water from snow. There is a marked absence of trails to water and the tracks going to water are low in proportion to the number of animals using the range on elk and mule deer ranges.

While analysis has been factor by factor it is evident that inter-relations of factors are probably more important in establishing the environmental relations. The following is an attempt to synthesize combinations which best illustrate the types of range found in areas used by the species of animals studied.

Inter-relations of such factors as cover, slope, and exposure are such that certain patterns exist. These patterns are presented in the form of a Game Range Index (See Figure 21a and b). The patterns are the result of this study and observations made at other than during the study period. The purpose of this Index is to indicate the various patterns that exist on a year long range and indicate which patterns are used in winter. An effective comparison can then be made

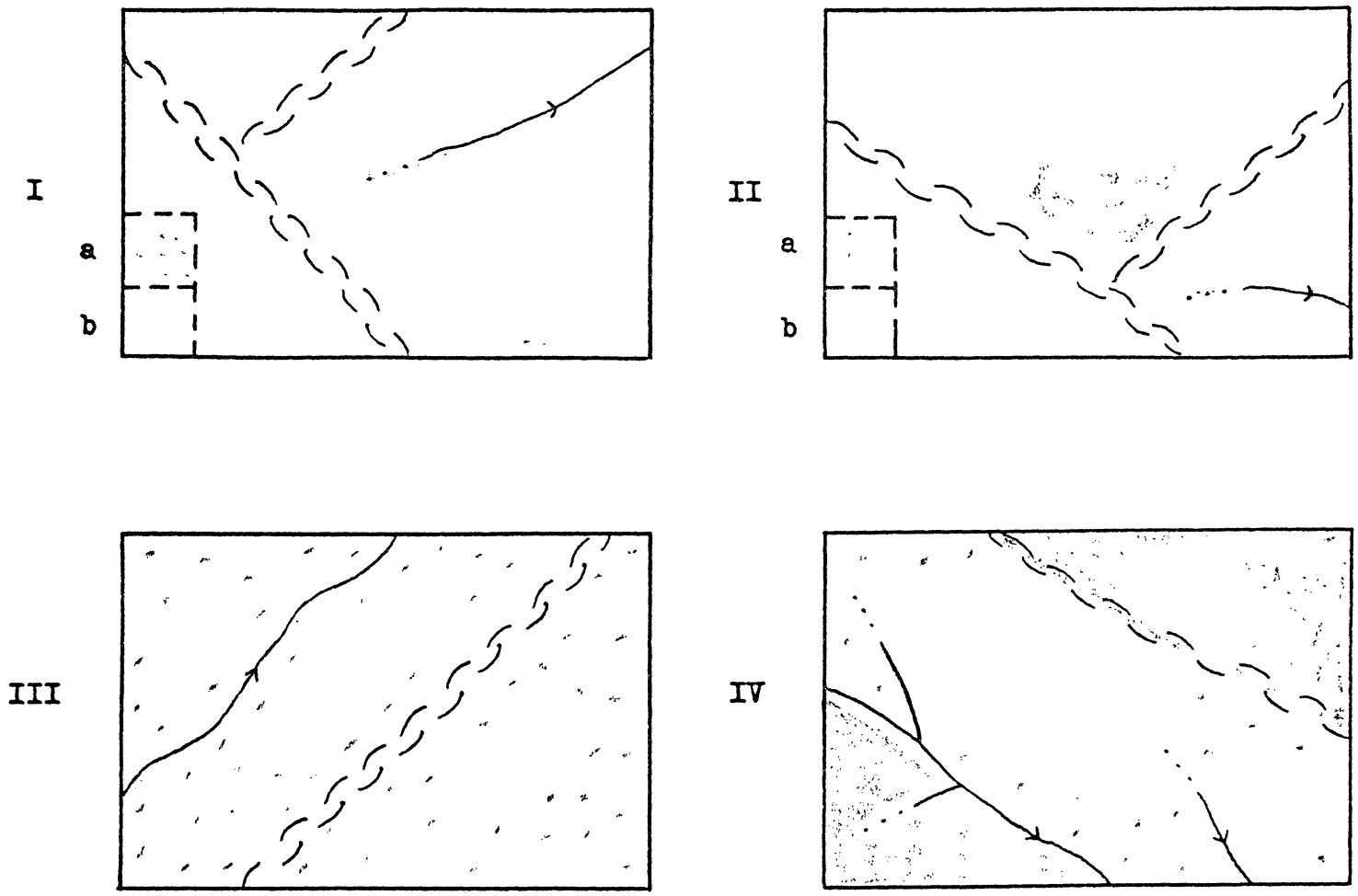
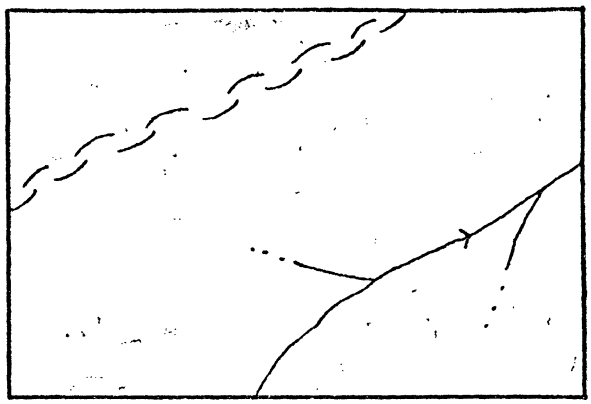
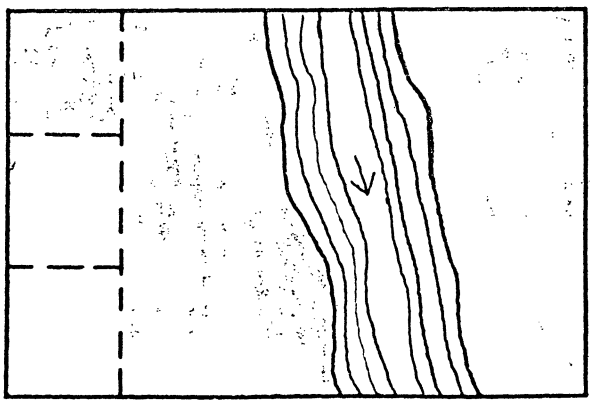


Figure 21a. Game Range Index.



V

VI



VII

Legend
grass
brush
timber

Figure 21b. Game Range Index.

between winter range and the other seasonal ranges.

In presenting these patterns it is not possible to show every detail and in the application of a Game Range Index blending of the patterns would require an inclusive description, i.e. area B has an index of III to IV. Affecting the above usage would be the size of the area mapped. The Index is broken down into the broad categories of grass, brush, and timber. The cover patterns are not based on any percentile relations or densities. Contradicting the last statement slightly, the timber is broken down into scattered or open and closed but not necessarily dense stands. This broad use of density is not a poor system of classification, because the patterns presented here are basic and they lend themselves to adaptation if an observer would require density classes, vegetative types etc. in his work.

Following is the proposed indices description and their relation to big game:

Index I. Characterized by rolling country and brushy draws. It may be sub-indexed as (a) to indicate a brush cover or (b) a grass cover. This type was not well represented in this study but it is used moderately by mule deer and is the historical winter range of elk. This is comparable to a grass-sagebrush area studied on the area east of the Boyd Ranch.

Index II. Characterized by rolling country with small patches of timber or it may be in steeper country in an old burn where only scattered groups of timber were left. If the non-timbered areas are brush covered it would be sub-indexed as (a) and if grass covered the sub-index would be (b). The rolling type of country with grass or brush cover is used moderately to heavy by mule deer. In the case of old burns any species of animal may be found depending on location. This was not well represented but is the result of observations made.

Index III. Characterized by open timber usually in rolling country with little moisture differentiation between exposures. This may also be applied to a logged over area where moisture differences exist. There are many clearings and an interspersion of grass and brush. The type of understory, both timber reproduction and brush, would determine the degree of use by white-tailed deer. If the understory was sparse and open it would be lightly used by white-tailed deer because of lack of escape cover. This pattern was well represented in this study and was used moderately to heavy by all animals depending on such factors as snow depth and cover.

Index IV. Characterized by a moisture differential between north and south facing slopes. The north slopes would have heavier timber and usually of a different type than the south

slopes. The south slopes are drier and have open stands of timber. The brush and grass understory varies with the exposure. The south exposure produces more palatable browse than the north exposure. The use of this area by animals depends on the character of the slope. This pattern is used heavily by white-tailed deer if the slopes are short or broken into benches. The white-tailed deer find excellent escape cover in this pattern. Mule deer and elk use this pattern moderately but they prefer the longer slopes. This pattern was the most common one encountered during this study.

Index V. Heavy timber interspersed by small clearings due to some disturbance. This area had very little use by deer due to the heavy snow accumulation. Elk made moderate use of this type. This type and north slopes in type IV are the patterns that elk will retire to in the daytime.

Index VI. Heavy timber over entire area on both north and south exposures. This type produces very little food, and snow accumulation is heavy. This is characteristic of a white pine-hemlock type (not found in the study area) or lodgepole type. This type is of little importance to game on winter range and was represented by a lodgepole type in the areas studied.

Index VII. Characterized by cottonwood bottoms of larger streams. There is usually an interspersion of conifers

mostly yellow pine or juniper. Many shrubs are found in this type. Sub-index (a) indicates a timber type adjacent to the bottom, (b) an adjacent brush type and (c) a grass type adjacent to the bottom. This is heavily used by white-tailed deer until the snow becomes deep enough to drive them out onto the more open hills, but they will maintain trails through this type to the stream for their water supply. This pattern was of little importance in the areas studied except for water.

These Game Range Indices are so set up that they can be determined on the ground or from aerial photos with some ground control.

SUMMARY

1. This study was prompted by reports of well-defined concentrations of big game, by species, in winter. The object of the study was the analysis of some environmental relationships to determine which ones might be affecting the distribution of white-tailed deer, mule deer, and elk on winter ranges.

2. Twenty areas of extensive study, one area of intensive study and one observation area were selected for analysis. The extensive study areas were visited in early winter (January) and late winter (March). The intensive area was visited the first weekend in November, December, January, and March. The observation area was visited in February and March.

3. Form C-1 was prepared for recording information from the various areas studied. Data on snow depth, slope, exposure, cover, browse density, browse use, tracks, and animals seen were recorded on this form. Vegetative data was taken by the ocular-estimate by weight method on five foot by one hundred foot plots at five chain intervals.

4. The temperature was close to average. It was slightly below normal in November, January, March, and April, but during December and February it was several degrees

above normal. The precipitation was average, some stations showing slightly below normal and others above normal. Snow accumulation was below normal due to several warm periods.

5. Deer and elk show definite seasonal and local distribution patterns. These patterns are affected directly or indirectly by such factors of the environment as: snow depth, cover, exposure, slope, composition of browse and browse food habit.

6. Snow depth controls the extent of winter range. White-tailed deer prefer less snow than mule deer and elk. Elk will range into deeper snow than the deer.

7. Cover of the ponderosa pine types are preferred by white-tailed deer. Mule deer were less selective, they used the Douglas fir and grass types more than white-tailed deer. Elk were not selective. Heavy cover was used by white-tailed deer for escape cover and by elk for bedding down during the day.

8. Exposures preferred by the white-tailed deer are the south facing areas. Mule deer range more widely on western exposures and rolling country. Elk did not show much preference for exposure, unless snow became too deep on northern exposures.

9. The character of the slope exerts the greatest influence on animals. White-tailed deer prefer the gentle slopes or steeper slopes if the latter are short and cut by benches. Mule deer used the long, steep slopes and elk showed little preference, except that little use was made of slopes over forty per cent.

10. Composition of shrubs on the various ranges were largely a reflection of the snow depth, cover, and exposures used by the animals. White-tailed deer areas contained shrubs characteristic of ponderosa pine types. Mule deer had a higher representation of shrubs from Douglas fir and grassland areas. Elk had a higher percentage of bottom types represented.

11. Browse food habits were based on the six species composing over ninety-five per cent of the browse taken. The plants were serviceberry, chokecherry, ceanothus, willow, mountain maple, and dogwood. All species of animals studied took serviceberry heavily. White-tailed deer preferred chokecherry and ceanothus next to serviceberry. Mule deer, while taking chokecherry moderately on extensive areas consumed more willow and mountain maple than white-tailed deer. Elk showed a high use of mountain maple and willow. Dogwood was utilized by elk and the only deer observation on dogwood use was during the January visit to the extensive

area where mule deer were using it lightly. The mule deer showed the greatest versatility in food habit.

12. On several occasions white-tailed deer and mule deer were observed bedding and feeding together.

13. White-tailed deer indicated a need for open water by maintaining well defined trails to water. Mule deer and elk obtained more of their moisture from snow.

14. Inter-relations of such factors as cover, slope, and exposure are such that certain patterns exist. These patterns are presented in the form of a Game Range Index. Indexes III and IV composed the bulk of the winter range in the study areas.

CONCLUSIONS

Strongly influencing the white-tailed deer was the depth of snow. Where the snow depth was over fifteen inches there was little use. The southernly exposures were heavily used and the more northernly exposures were used only for escape or protection from wind. The ponderosa pine types are the preferred cover types. White-tailed deer preferred the open ponderosa pine types but required clumps of reproduction or heavily timbered north slopes as part of the cover pattern. This need for escape cover is reflected in the use of short slopes or broken slopes. In these areas serviceberry and chokecherry are the major food items. Open water should be available within one third of a mile from the center of concentration areas. The distance to open water was probably the most important factor affecting the limits of white-tailed deer winter range. Photographs 7 to 12 inclusive were taken on white-tailed deer winter range.

Mule deer winter range was not as limited as white-tailed deer winter range because of the versatility of the mule deer. Mule deer are not limited by a need for open water. The long, steep, open slopes or rolling country are highly preferred. The mule deer used the more open cover types such as grass, ponderosa pine and open Douglas fir.

Mule deer will range into deeper snow and heavier cover than white-tailed deer. They use the western exposures quite extensively. Mule deer show a versatile food habit and adjust themselves readily to the browse available. The mule deer generally are quite versatile in their environmental requirements. Photographs 13 to 19 inclusive were taken on mule deer winter range.

Elk show no set pattern, their adaptability to all the variations within the factors studied is such that no real environmental requirements can be stated. Photographs 20 to 22 inclusive were taken on elk winter range.

During this winter period competition between animals revolved around mule deer. Had the snow accumulation been heavier and moved the elk down onto the deer range the picture would have been different. Instead, mule deer in most cases were the "buffer" species, overlapping both elk and white-tailed deer range.

The results of this study will find practical application within the limits of the climatic conditions encountered and with some restrictions for deeper snow, likely to be encountered, may be applied to areas comparable to the areas studied. By using the Game Range Index to locate possible wintering areas and then checking on the

various factors of the environment it is possible to determine the suitability of an area for a winter range and the species of animal best adapted. The wildlife technician planning a restocking program or management of an area where several species are in competition should investigate the game range to determine its suitability.

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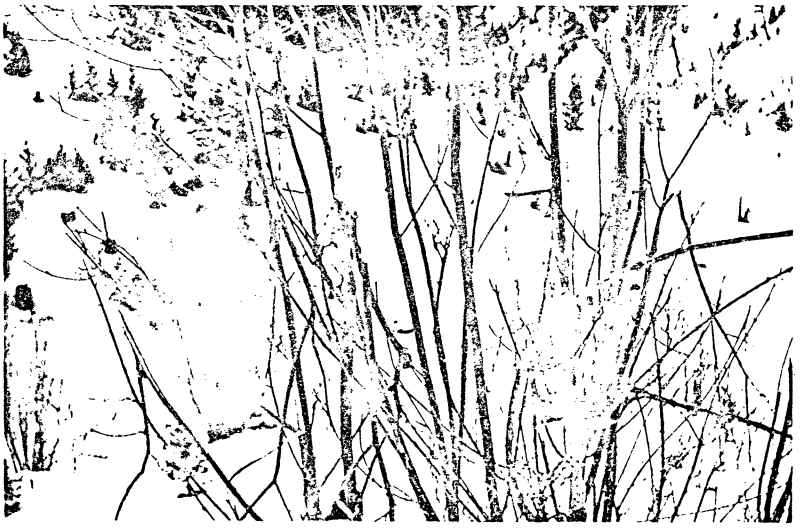
Photograph 1. Breakage of mountain maple by elk. Some of the breaks are as high as seven feet from the ground.
Cap Wallace Gulch.March 1951

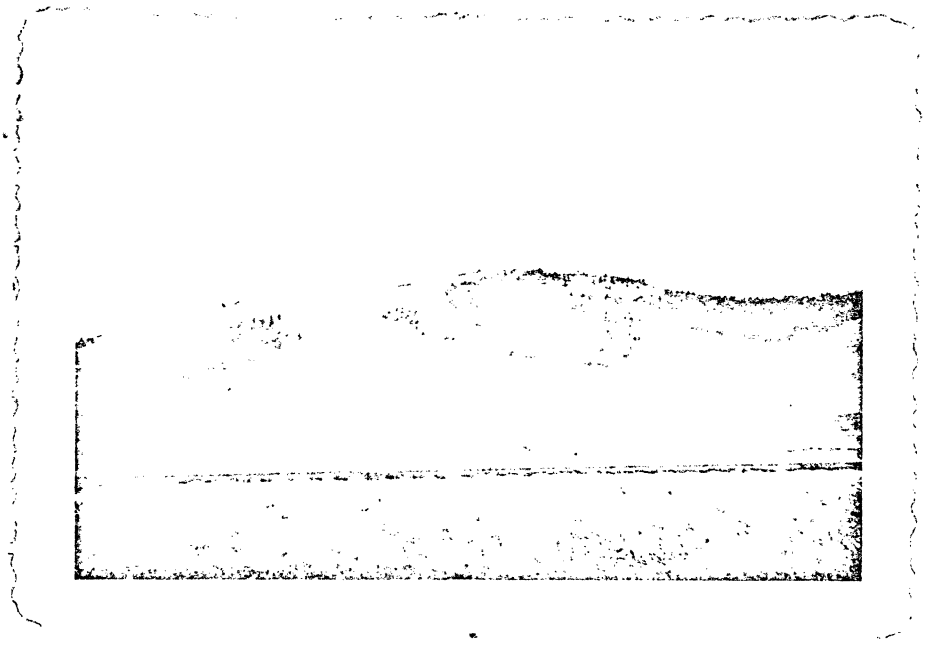


Photograph 2. Breakage of mountain maple by elk.
Cap Wallace Gulch.March 1951

Photograph 3.(left) Heavy utilization of rocky mtn. juniper by mule deer.

East of Boyd Ranch. March 1951.

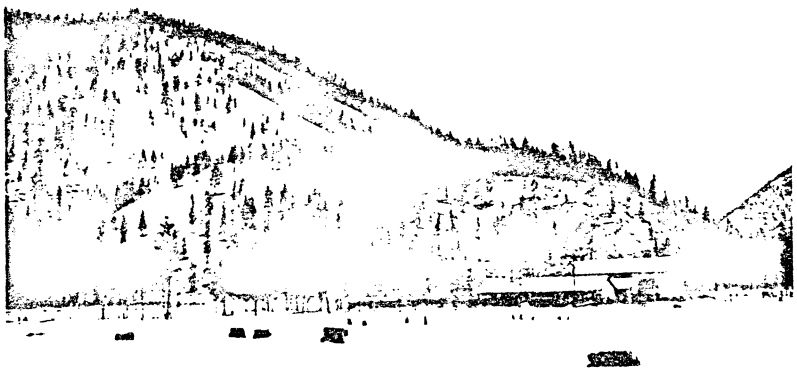
Photograph 4.(right) Heavy utilization of upland willow by elk. Dry Cottonwood Creek. March 1951



Photograph 5. Bison range, showing relations of grass and timber. There were 47 elk bedded down in the timber in the center of the picture. At the same time muledeer were bedded down on the grass slopes. May 1951

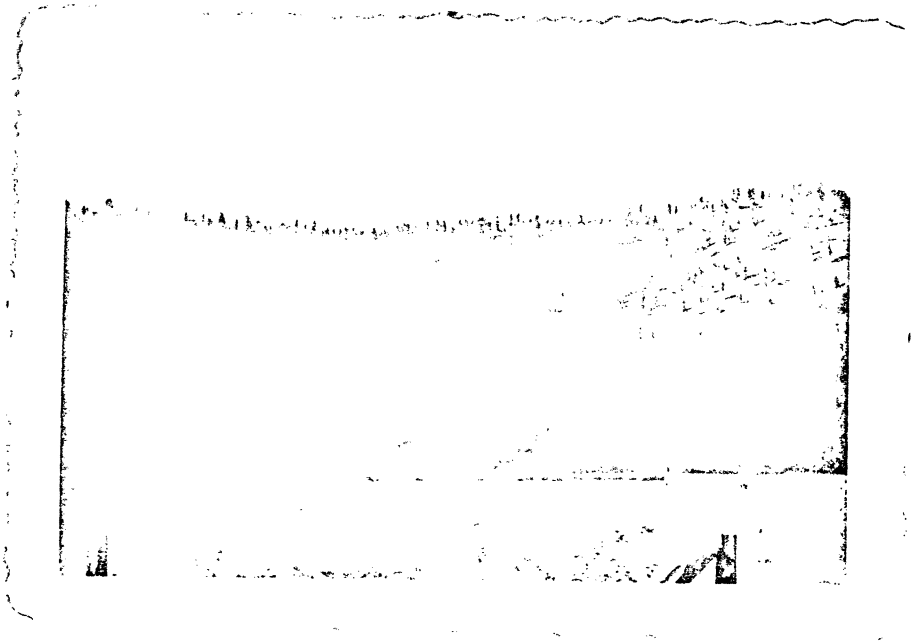
Photograph 6. Dead mule deer buck killed probably by coyotes. Coyotes were the principal predators encountered in the study area. Cougar activity was observed on only three occasions.

Potomac.April 1951.

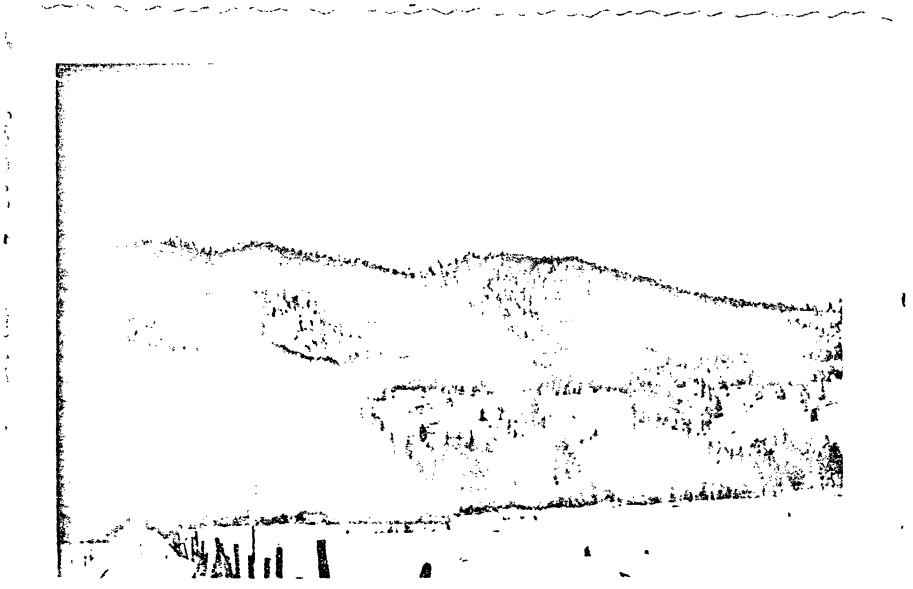


Photograph 7. White-tailed deer winter range. The bench with heavier timber was favored by the deer. Gilbert Creek. January 1951.

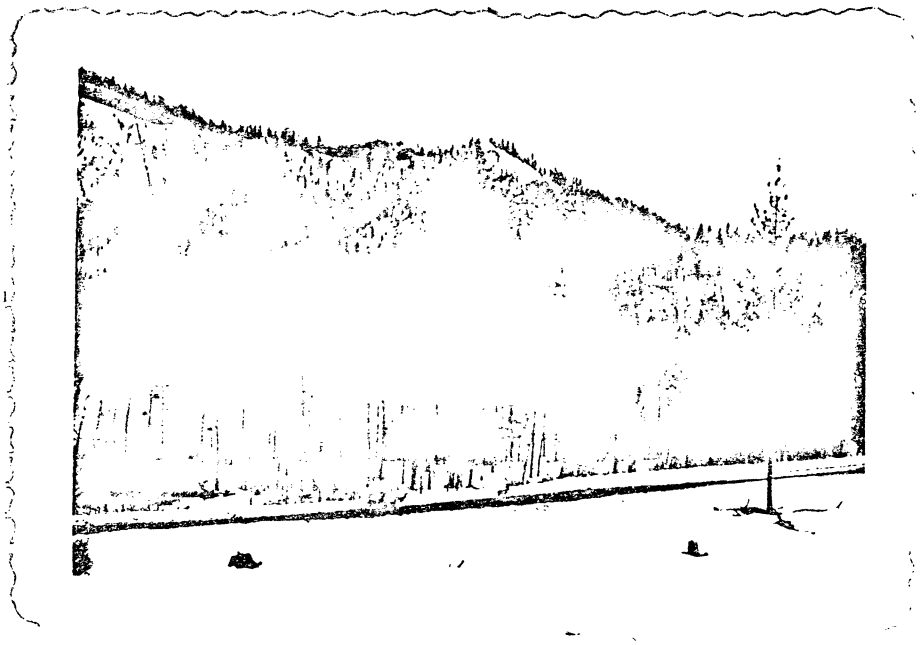
Photograph 8. White-tailed deer winter range. The short slopes, heavier timber for escape and adjoining bottom with running water are characteristic. Schwartz Creek. 1951.



Photograph 9. Whitetailed deer winter range.
Bonita.March 1951



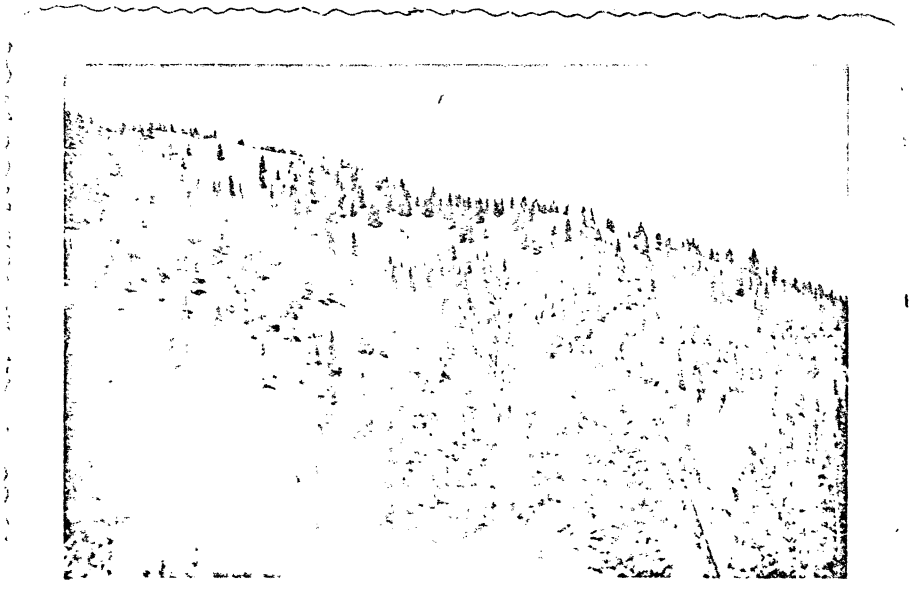
Photograph 10. Whitetailed deer winter range.
West of Turah.January 1951



Photograph 11. White-tailed deer winter range. Four deer are crossing the county road on their way to water. Well defined trails crossed the bottom. South of Boyd Ranch.March 1951

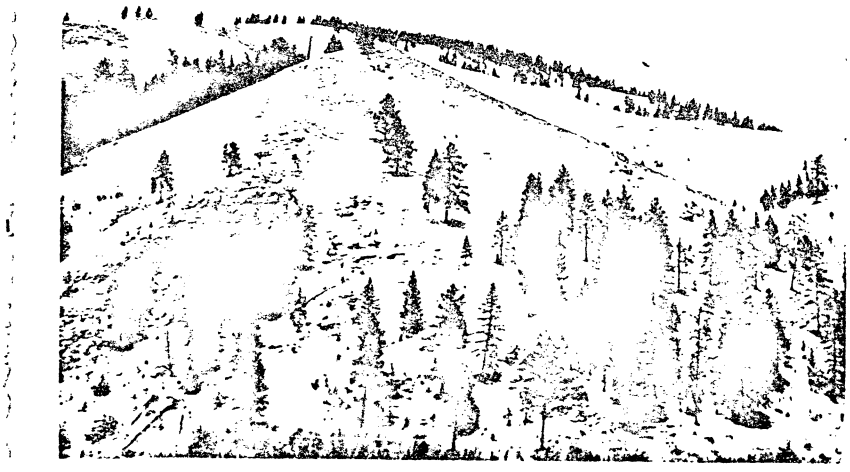
Photograph 12. Three white-tailed deer are feeding on this hillside. Notice the short slope, nearness of escape cover and water in the draw. Kitchen Creek.January 1951.

Photograph 13. Long steep slopes characteristic of many mule deer ranges. The mule deer ranged to the top of this slope, a distance of over one mile. Several white-tailed deer wintered on the small bench in the foreground, close to water in the valley. Hill opposite Gilbert Creek.January 1951.



Photograph 14. Mule deer winter range. Open country with steep slopes. Quigley Creek.March 1951.

Photograph 15. Mule deer winter range. Three mule deer feeding. One-half mile north of Babcock Creek. January 1951.



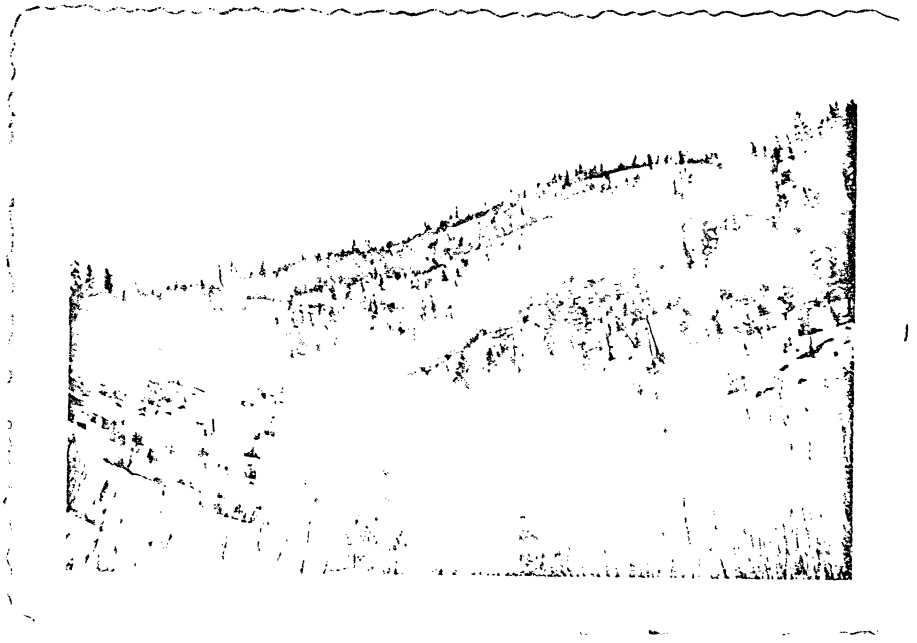
Photograph 16. Mule deer winter range. Eight mule deer feeding. Hill north of Babcock Creek. January 1951.

Photograph 17. Open rolling country used by mule deer for winter range. A herd of over 25 mule deer wintered in this area. East of Boyd Ranch.March 1951.

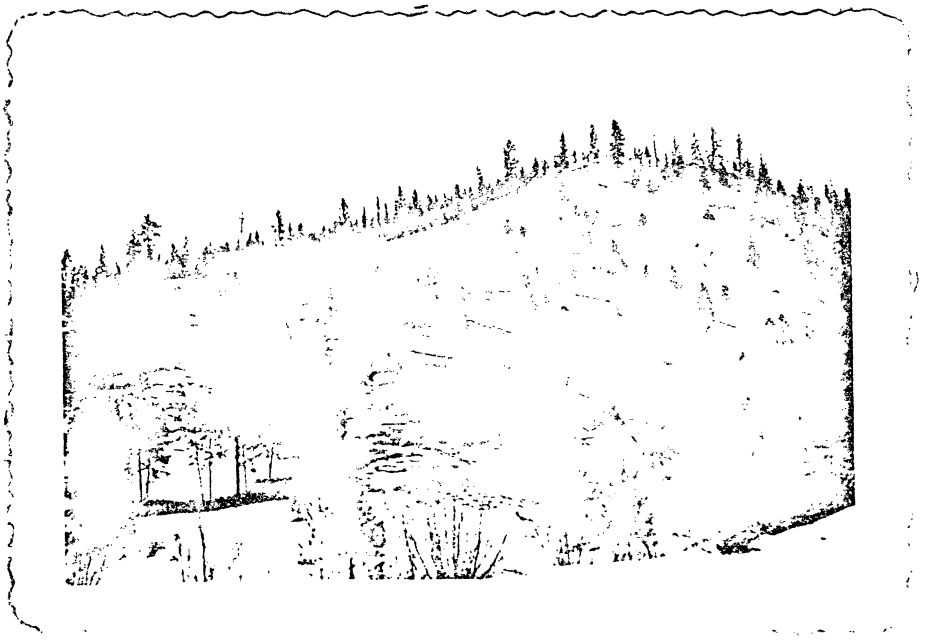
Photograph 18. ..uledeer winter range. This is some of the heavier cover used by mule deer. This slope was quite steep. By looking close the talus rock can be seen. Potomac.April 1951.

Photograph 19. Mule deer winter range. The snow was rather deep in this area all winter. West Twin Creek.March 1951.

Photograph 20. This picture was taken about a mile further up the drainage than photograph 19. This area was used by elk. The snow was deeper and the elk would bed in the timber during the day and feed out on the slope at night. West Twin Creek.March 1951.



Photograph 21. Elk winter range. The bottom was used quite heavily for forage. Cap Wallace Gulch.March 1951.



Photograph 22. Elk winter range. This picture was taken in late March when the snow was receding. Cap Wallace Gulch. March 1951.

Table 8. Percent distribution of plots.

	Extensive Areas 1504 plots			Intensive Area 958 plots		
Snow Depth	White tail	Mule deer	Elk	White tail	Mule deer	Elk
0-5	19.3	21.6	2.8	11.8	9.9	4.8
6-10	33.1	20.3	8.1	36.8	27.5	12.9
11-15	21.9	23.0	17.5	29.4	27.5	25.1
16-20	21.1	20.2	36.8	9.8	21.2	38.0
21-25	2.0	10.0	5.3	4.7	7.5	10.8
26-30	2.6	4.9	29.5	7.5	6.4	8.4
	100.0	100.0	100.0	100.0	100.0	100.0
Exposure						
North	6.2	8.5	22.3	15.2	20.8	21.4
Northeast	3.9	2.9	1.3	5.1	1.8	1.0
East	12.1	2.3	4.2	5.4	6.2	7.4
Southeast	14.7	4.7	10.4	2.0	2.4	4.0
South	20.3	16.5	7.2	33.4	30.8	18.8
Southwest	22.1	28.4	13.0	11.5	5.1	2.6
West	6.6	7.8	9.5	8.4	5.1	3.8
Northwest	6.7	6.7	2.8	1.0	2.6	2.8
Level-Rolling	6.9	22.2	29.3	18.0	25.2	38.2
	100.0	100.0	100.0	100.0	100.0	100.0
Slope						
0-4	9.5	22.9	29.3	32.2	40.9	54.7
5-14	34.8	24.4	25.9	33.5	25.2	19.9
15-24	23.6	20.3	27.7	14.9	18.8	14.3
25-34	14.2	12.4	7.9	9.1	7.7	6.2
35-44	13.9	15.3	0.9	6.4	3.9	2.8
45 plus	3.9	4.7	8.3	3.9	3.5	2.1
	100.0	100.0	100.0	100.0	100.0	100.0
Cover						
Meadow	0.6	0.3	-	-	-	-
Willow	-	0.9	0.7	0.4	0.5	0.7
Grass	-	10.8	-	2.7	17.6	3.9
Pine-Grass	20.4	13.8	4.7	11.9	4.4	1.9
Pine-Fir	63.8	40.4	37.2	48.7	37.6	24.4
Pine-Fir-Larch	3.3	2.6	2.1	4.2	4.2	4.6
Fir-Larch	1.1	6.5	29.8	13.5	21.9	55.3
Fir	9.4	20.1	17.4	14.6	12.3	9.2
Lodgepole pine	-	1.4	0.5	4.0	1.5	-
Upland browse	1.4	3.2	7.1	-	-	-
Spruce	-	-	0.5	-	-	-
	100.0	100.0	100.0	100.0	100.0	100.0

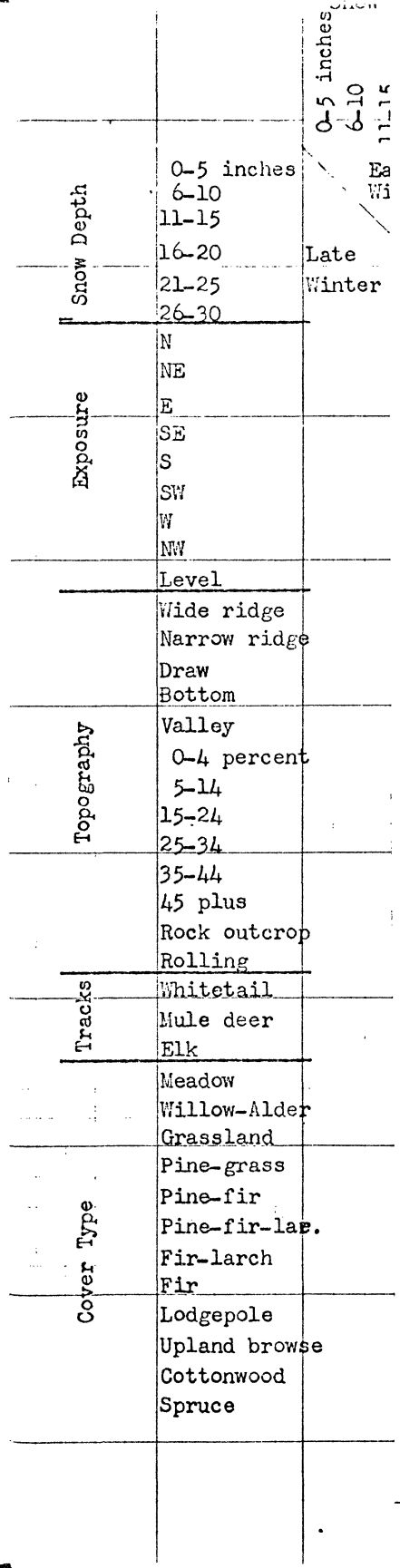
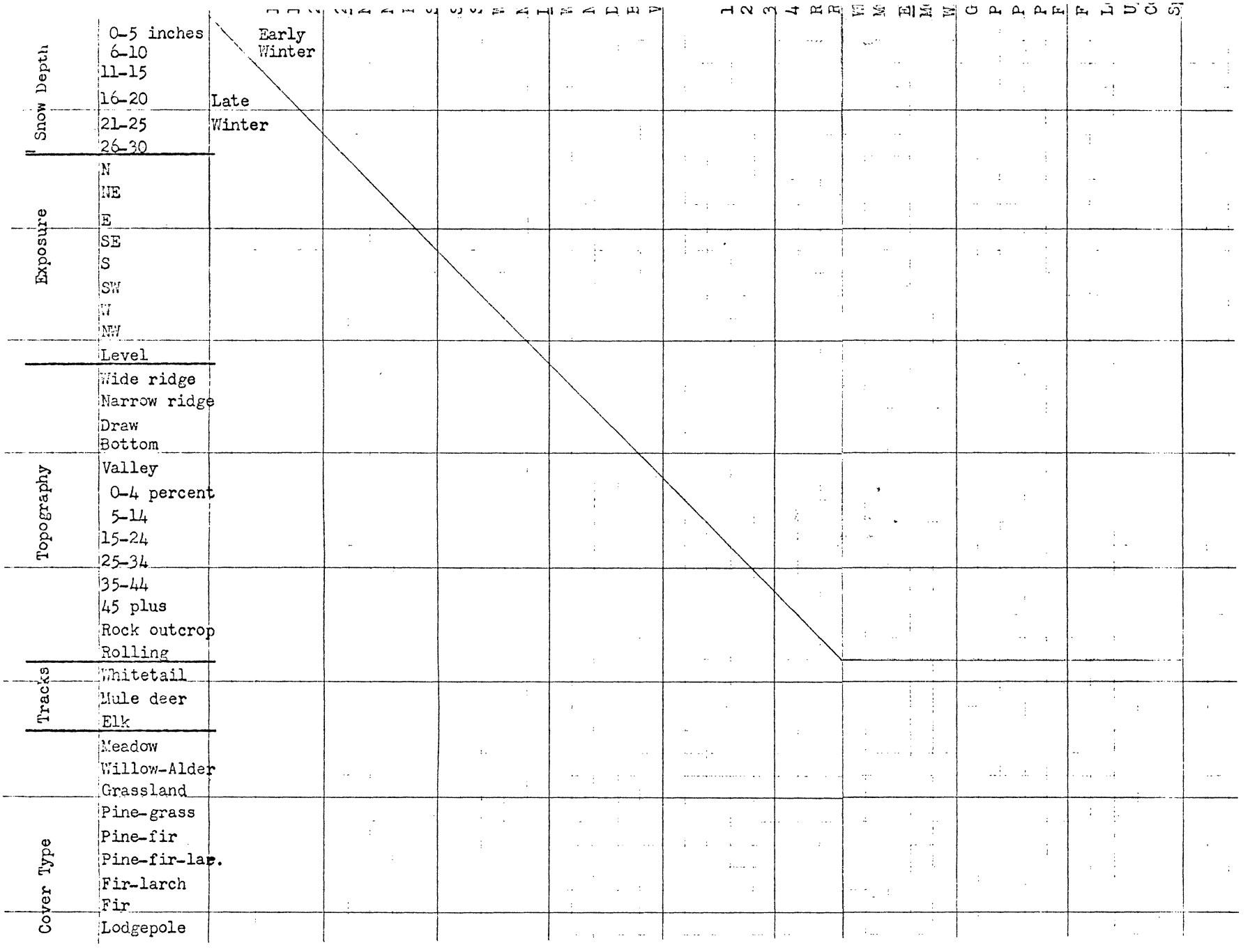


Figure 22. Plot record sheet for one area.


Snow Depth
0-5 inches
6-10
11-15
16-20
21-25
26-30
Early Winter
Late Winter
Exposure
N
NE
E
SE
S
SW
W
NW
Level
Wide ridge
Narrow ridge
Draw
Bottom
Valley
Topography
0-4 percent
5-14
15-24
25-34
35-44
45 plus
Rock outcrop
Rolling
Tracks
Whitetail
Mule deer
Elk
Meadow
Willow-Alder
Grassland
Cover Type
Pine-grass
Pine-fir
Pine-fir-lar.
Fir-larch
Fir
Lodgepole